

# Prep 1

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# UNIT( 1 )

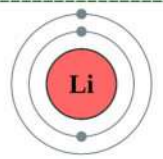
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Chemical Substances

## Lesson one

### 1 Metals:

1 The last energy level in their atoms ends with 1, 2 or 3 electrons.  
example : Lithium ( ${}_3\text{Li}$ )



2 All of them are solids ,  
except: mercury the only liquid metal.



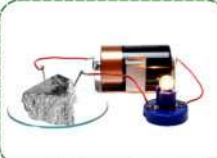
3 They have metallic luster (shiny).  
example : Sodium



4 Malleable, ductile and formable.  
example : Copper



5 Good conductors of heat (thermal conductors).  
example : zinc



6 Good conductors of electricity (electrical conductor).  
example : Aluminum



7 They have high melting points.  
example : Iron.



Examples of  
metals:

Sodium

Zinc

Iron

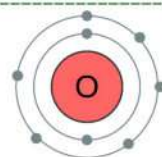
Copper

Silver

Gold

# 1 Nonmetals

1 The last energy level in their atoms **ends with 5, 6 or 7 electrons**  
**except:** hydrogen (1 electron) and carbon (4 electrons).



2 They are either solids or gases ,  
**except:** bromine element : " the only liquid nonmetal."



3 They do not have luster (opaque).  
example : Sulphur



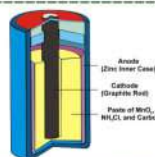
4 Not malleable or ductile (brittle).  
example : Carbon (graphite)



5 Bad conductors of heat. (electrical insulator ).  
example : Phosphorus



6 Bad conductors of electricity,  
**except:** graphite → which is used in dry cells.



7 Their melting points are low.  
example : Iodine.



Examples of  
metals:

Carbon

Phosphorus

Iodine

Sulphur

Bromine

oxygen

**Solids Nonmetals** : Carbon (graphite), sulphur, phosphorus and iodine.

**Liquid Nonmetals** : Bromine (The only liquid nonmetal).

**Gases Nonmetals** : Hydrogen, oxygen, nitrogen, and chlorine.

NOTES

Solid metal atoms are arranged in a **metallic crystal lattice**, where they exist as positive ions (cations) surrounded by a cloud of free-moving valence electrons.

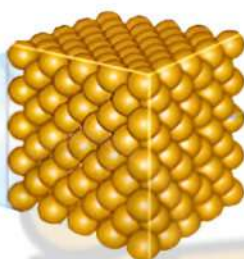


**Metallic Bond**

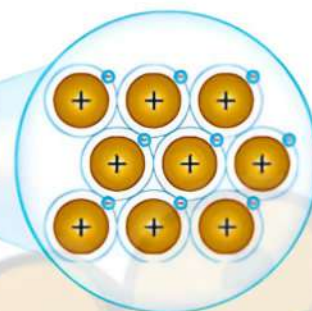
The attraction force between the **positive metal** ions and the **negative valence electron cloud** which surrounds them.



Copper metal



The crystal lattice of copper metal



Metallic bond

**Importance  
Metallic Bond**

**physical  
properties**

hardness of metals

high melting points of metals.

When the number of valence electrons increases.

the strength of metallic bond increases.

the hardness of metals increases.

the melting points of metals increase.

Pure metals are **soft** and **unsuitable** for industrial use.

**Therefore**, one or more molten metals are **added to another** molten metal to **form an alloy**, which has different properties from its original elements.

**alloy**

A mixture composed of the melts of two or more metals.

**Example**

**Bronze Alloy**

- ◆ **Components** : 95% Copper + 5% Tin.
- ◆ **Properties** : Harder than copper and resistant to rust.
- ◆ **Uses** : Used in jewelry, medals, and statues.



## Metal Recycling

## Recycling

The process of the conversion of the wastes into new usable substances.

Some metals, such as copper, aluminum, and iron, are recycled for the following reasons:

1. Their percentage in the Earth's crust is decreasing.
2. Extracting them from their ores is difficult.
3. Recycling is much cheaper than extraction.

## words of the lesson

Metals	الفلز	attraction force	قوة الجذب
Nonmetals	اللافلزات	hardness	الصلابة
metallic luster	اللمعان المعدني	valance	التكافؤ
opaque	معتم	industrial	صناعي
Malleable	قابل للطرق	unsuitable	غير مناسبة
ductile	قابل للسحب	alloy	سبائك
formable	قابل للتشكيل	mixture	خليط
conductor	موصل	composed of	مكون من
melting point	نقطة الانصهار	Recycling	إعادة التدوير
arrange	ترتيب	percentage	النسبة المئوية
metallic crystal lattice	شبكة بلورية فلزية	Extract	استخراج
positive ion	أيون موجب	cheap	رخيص
Metallic Bond	رابطة فلزية	conversion	تحويل
crumbles	يتفتت	despite	بالرغم من

## Questions



EL-MOASSER

## 1 Choose the correct answer:

- 1 The strength of the metallic bond increases with the increasing the number of the .....  
**a** protons in the nucleus. **B** energy levels. **C** valence electrons. **D** neutrons in the nucleus.
- 2 Copper is a component of the bronze alloy, its percentage is.....  
**a** 5% **B** 15% **C** 65% **D** 95%
- 3 The liquid element which is bad conductor of heat and electricity is.....  
**a** bromine **B** chlorine **C** mercury **D** lithium
- 4 The hardest element of the following is .....  
**a** Al (13) **B** Cl (17) **C** Mg (12) **D** Na (11)
- 5 The last energy level of metal atoms contains .....  
**a** 1: 3 electrons **B** 3: 5 electrons. **C** 5: 7 electrons **D** 8 electrons.
- 6 The metallic bond exists between .....  
**a** atoms of different metals. **B** atoms of the same metal.  
**C** positive ions and negative ions. **D** atoms of metals and hydrogen
- 7 All the following are properties of sodium element, except .....  
**a** a metal **B** has metallic luster.  
**C** bad electrical conductor **D** formable.
- 8 Which of the following questions helps in the classification of some elements to metals and nonmetals ?  
**a** Is it solid ? **B** Is it liquid ? **C** Is it coloured ? **D** Is it brittle ?
- 9 What is the common property of both sodium and copper ?  
**a** Colour **B** Density **C** Melting point **D** Physical state
- 10 A colorless gas in the room temperature could be from.....  
**a** metals **B** nonmetals **C** alloys **D** metalloids

2 Complete the following statements :

- 1 The outermost energy level of most nonmetallic elements contains more than .....electrons and less than ..... electrons.
- 2 The .....elements are bad conductors of heat and electricity, except ..... which is a good conductor of electricity.
- 3 .....are characterized by being ductile, malleable and formable, while ..... are characterized by being brittle (not ductile or malleable or formable).
- 4 As the number of valence electrons of the metal atom ..... , the strength of its metallic bond .....
- 5 The bronze alloy is formed by adding ..... metal to..... metal.

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 Lithium and sulphur can be differentiated by electrical conductivity. ☐
- 2 Sodium is a soft metal with a melting point lower than that of nonmetals. ☐
- 3 Sulphur is used in dry cells. ☐
- 4 Bromine is a liquid element with metallic luster. ☐
- 5 Pure gold metal is harder than gold alloys. ☐

4 Write the scientific term for each of the following statements :

- 1 Elements that have metallic luster and are good conductors of heat and electricity.
- 2 Brittle elements that are not malleable or ductile or formable.
- 3 A nonmetallic element that is a good conductor of electricity.
- 4 A mixture composed of the melts of two metals or more.
- 5 The process of the conversion of the wastes into new usable substances.

### 5 What is meant by each of the following :

- |             |                      |                    |
|-------------|----------------------|--------------------|
| (1) Metals. | (2) Nonmetals.       | (3) Metallic bond. |
| (4) Alloys. | (5) Metal recycling. |                    |

### 6 Choose the odd word out, then state the relation between the rest:

1 Magnesium / Copper / Mercury / Silver.

2 Lithium / Sodium / Calcium / Carbon.

3 Aluminum / Nitrogen / Hydrogen / Iodine.

4 Graphite / Sulphur / Chlorine / Oxygen.

### 7 State one difference between each of the following:

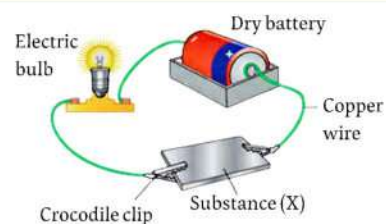
1 Sulphur and copper.

2 Sodium and graphite.

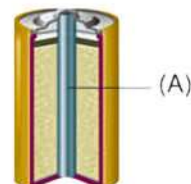
3 Zinc and phosphorus.

### 8 Study the following figures, then answer the questions:

- 1 In the opposite figure :  
What happens to illuminate the bulb,  
with explanation when the substance (X)  
is replaced with each of the following :  
(1) A piece of graphite. (2) A piece of sulphur.



- 2 From the opposite figure:  
(1) What does the figure represent ?  
(2) What is the name of the element from which  
part (A) is made? What is its important property?



## Lesson Two

## NOTES

- When a metal atom **loses** electron(s) : it becomes a **positive ion** (cation).
- When a nonmetal atom **gains** electron(s) : it becomes a **negative ion** (anion).
- The hydrogen cation  $H^+$  is the only positive ion derived from a nonmetallic element.

Ions could be:

**Cations** (positive ions)

## (Metallic element ions)

Lithium .....  $Li^+$ Sodium .....  $Na^+$ Potassium .....  $K^+$ Silver .....  $Ag^+$ Magnesium .....  $Mg^{2+}$ Calcium .....  $Ca^{2+}$ Zinc .....  $Zn^{2+}$ Barium .....  $Ba^{2+}$ Aluminum .....  $Al^{3+}$ **Anions** (negative ions)

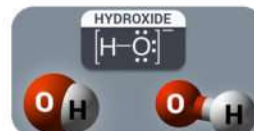
## (Nonmetallic element ions)

Fluoride .....  $F^-$ Chloride .....  $Cl^-$ Bromide .....  $Br^-$ Iodide .....  $I^-$ Oxide .....  $O^{2-}$ Sulphide .....  $S^{2-}$ 

The name of the anion ends with the suffix **(-ide)**.



**Atomic Group**  
(polyatomic ion)



- An ion composed of more than one atom of more than one element.
- carries a number of **positive** or **negative** charges.
- Ammonium ( $\text{NH}_4^+$ ) is the only positive atomic group.

**Examples of some atomic groups and their molecular formulas**

Atomic group	Molecular formula	Atomic group	Molecular formula
Hydroxide	$\text{OH}^-$	Carbonate	$\text{CO}_3^{2-}$
Nitrate	$\text{NO}_3^-$	Sulphate	$\text{SO}_4^{2-}$
Nitrite	$\text{NO}_2^-$	Sulphite	$\text{SO}_3^{2-}$
Bicarbonate	$\text{HCO}_3^-$		
Chlorite	$\text{ClO}_2^-$	Phosphate	$\text{PO}_4^{3-}$
Ammonium	$\text{NH}_4^+$		

**Acids and Alkalis**

**1 Acids**

They are substances that dissolve in water and give positive hydrogen ions  $\text{H}^+$ .

**Example :**  $\text{HCl}$  ( Hydrochloric acid )

**Hydrogen ion**



**Naming Acids and Their Relation to Anions**

◆ The name of an acid is based on the anion that forms it, depending on its type:

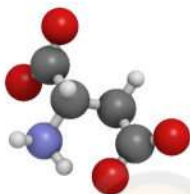
- 1 If the anion consists of a single nonmetal element (excluding oxygen), the acid is named accordingly.
- 2 If the anion is a negatively charged atomic group (excluding the hydroxide group  $\text{OH}^-$ ), the acid's name is derived from that group.
- 3 Acids that contain oxygen in their atomic groups are called oxyacids.

Acids are classified into:

Acids that contain oxygen (oxyacids)

Naming Acids That Do Not Contain Oxygen

1. The name begins with the prefix "Hydro-".
2. Followed by the name of the anion.
3. The "-ide" suffix of the anion is replaced with "-ic" in the acid's name.
4. The name ends with "acid".



Example:

- Chloride ( $\text{Cl}^-$ ) → Hydrochloric acid ( $\text{HCl}$ ).

Acids that don't contain oxygen

Naming Oxyacids

1. The name begins with the name of the anion (the negatively charged atomic group).
2. For anions ending in "-ate", replace the suffix with "-ic" in the acid's name.
3. For anions ending in "-ite", replace the suffix with "-ous" in the acid's name.
4. The name ends with "acid".

Examples:

- Nitrate ( $\text{NO}_3^-$ ) → Nitric acid ( $\text{HNO}_3$ )
- Nitrite ( $\text{NO}_2^-$ ) → Nitrous acid ( $\text{HNO}_2$ )

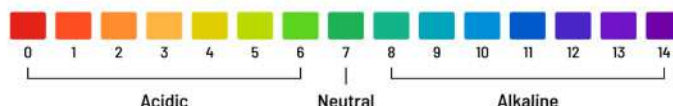
examples of some anions and their oxyacids

Anions ending with the suffix	( ate )	Acids of these anions have the suffix	( ic )
Nitrate	$\text{NO}_3^-$	Nitric acid	$\text{HNO}_3$
Sulphate	$\text{SO}_4^{2-}$	Sulphuric acid	$\text{H}_2\text{SO}_4$
Phosphate	$\text{PO}_4^{3-}$	Phosphoric acid	$\text{H}_3\text{PO}_4$
Anions ending with the suffix	( ite )	Acids of these anions have the suffix	( ous )
Nitrite	$\text{NO}_2^-$	Nitrous acid	$\text{HNO}_2$
Sulphite	$\text{SO}_3^{2-}$	Sulphurous acid	$\text{H}_2\text{SO}_3$

Role of Acids in the Human Body

1. **Hydrochloric acid** : Secreted by the stomach, it plays a key role in food digestion.
2. **Lactic acid**: Produced during anaerobic respiration, it provides energy to muscles when oxygen is scarce. However, its accumulation in muscles can cause muscle cramps.

## pH scale



## 1 Alkalies

### Names of Alkalies :

The name of an alkali is based on the cation that composes it (excluding the hydrogen cation).

- The name **starts** with the name of the **cation**, followed by the word "**hydroxide**".

### Example:

- Sodium hydroxide (NaOH).

### examples of some alkalies and the cations which compose them :

Cation	Alkali molecular formula	Alkali name
Sodium $\text{Na}^+$	NaOH	Sodium hydroxide
Magnesium $\text{Mg}^{2+}$	$\text{Mg}(\text{OH})_2$	Magnesium hydroxide
Ammonium $\text{NH}_4^+$	$\text{NH}_4\text{OH}$	Ammonium hydroxide

## Properties of Acids and Alkalies

### Acids

a substance whose dissolution in water increases the percentage of **hydrogen cations  $\text{H}^+$**  in the solution.

#### Examples of acidic substances :

- Lemon. - Ketchup. - Grapes.

#### Dissolution of Acids in Water

- Hydrogen chloride (HCl) dissolves in water, forming  **$\text{H}^+$  cations** and  **$\text{Cl}^-$  anions**.
- Sulfuric acid ( $\text{H}_2\text{SO}_4$ ) dissolves in water, forming  **$\text{H}^+$  cations** and  **$\text{SO}_4^{2-}$  anions**.

In both cases, the dissolution of acids in water increases **the percentage of  $\text{H}^+$  cations** in the solution, **which are responsible for all the properties of acids**,

**effect on litmus paper** : blue TO red

### Alkalies

a substance whose dissolution in water increases the percentage of **hydroxide anions  $\text{OH}^-$**  in the solution.

#### Examples of alkaline substances :

- Detergents. - Toothpaste. - Baking soda.

#### Dissolution of Alkalies in Water

- Sodium hydroxide (NaOH) dissolves in water, forming  **$\text{Na}^+$  cations** and  **$\text{OH}^-$  anions**.
- Magnesium hydroxide ( $\text{Mg}(\text{OH})_2$ ) dissolves in water, forming  **$\text{Mg}^{2+}$  cations** and  **$\text{OH}^-$  anions**.

The dissolution of all alkalies in water increases **the percentage of  $\text{OH}^-$  anions** in the solution, **which are responsible for all the properties of alkalies**,

**effect on litmus paper** : red TO blue

- Acids do not react with each other, and likewise, alkalies do not react with each
- Acids react with alkalies, forming salts and water

## Electrical conductivity:

◆ Acids and alkalis conduct electricity to different (variant) degrees, according to their strength.

## Strong Acids

Acids that are **good** electrical conductors.

## Examples :

- Hydrochloric acid.
- Nitric acid.
- Sulphuric acid.

## Weak Acids

acids are **bad** electrical conductors.

## Examples :

- Vinegar (dilute acetic acid).
- Nitrous acid.
- Sulphurous acid.

## Formation and Properties of Metal Oxides

◆ When a metallic or nonmetallic element **burns in the presence of oxygen**, it forms a compound called an **oxide**.

◆ **Metal oxides** are typically basic oxides, and those that dissolve in water **form alkalis**.

## Example: Magnesium Oxide

- **Magnesium** burns in oxygen to form magnesium oxide ( $MgO$ ).
- $MgO$  dissolves in water, forming magnesium hydroxide ( $Mg(OH)_2$ ), which turns red litmus paper **blue**.

## Key Properties of Metal Oxides

- React **with acids** to form salts and water.
- **Do not** react with **alkalis**.

## Formation and Properties of Nonmetal Oxides

◆ When **nonmetals** burn in the presence of oxygen, they **form nonmetal oxides**, which are mostly acidic oxides.

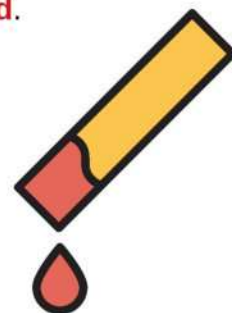
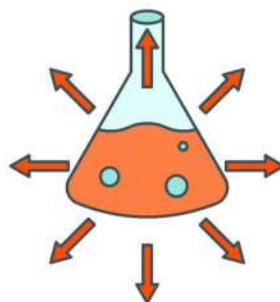
◆ **Acidic oxides** dissolve in water to form **acids**.

Example: Sulfur Trioxide ( $SO_3$ )

- **Sulfur** burns in oxygen to form sulfur trioxide ( $SO_3$ ).
- $SO_3$  dissolves in water, forming sulfuric acid ( $H_2SO_4$ ), which turns blue litmus paper **red**.

## Key Properties of Nonmetal Oxides

- React **with alkalis** to form salts and water.
- **Do not** react with **acids**.



## Acidrain

## Causes

- Burning fossil fuels (such as petrol and coal) in cars, power plants, and factories releases **acidic oxides** like:
  1. Nitrogen dioxide ( $\text{NO}_2$ )
  2. Sulfur dioxide ( $\text{SO}_2$ )
- These oxides dissolve in atmospheric water vapor and accumulate in clouds, **leading to acid rain precipitation.**

## Harmful Effects

1. Destruction of forests.
2. Harming aquatic organisms.
3. Corrosion of buildings.
4. Health problems affecting the human respiratory system.



## words of the lesson

Atomic group	مجموعة ذرية	Lactic acid	حمض اللاكتيك
Oxyacids	أحماض أكسجينية	muscle cramps	تشنجات عضلية
gains	يكتسب	dissolution	ذوبان
suffix	لاحقة	Detergents	المنظفات
charges	شحنات	percentage	نسبة
Acids	أحماض	responsible for	المسؤول عن
Alkalies	قلويات	Electrical conductivity	الموصلية الكهربائية
dissolve	يذوب	presence	وجود
depending on	اعتمادًا على	absence	غياب
excluding	باستثناء	Acid rain	الأمطار الحمضية
accordingly	وفقًا لذلك	accumulate	يتراكم
replace	استبدال	Destruction	تدمير
Secreted	يُفرز	Corrosion	تآكل
food digestion	هضم الطعام		

## Questions



EL-MOASSER

## 1 Choose the correct answer:

- 1 All the molecular formulas of the following ions are correct, except .....
- a** sulphate  $\text{SO}_4^{2-}$       **B** phosphate  $\text{PO}_4^{3-}$       **C** hydride  $\text{OH}^-$       **D** nitrite  $\text{NO}_2^-$
- 2 Which of the following expresses sulphite and nitrate ions respectively?
- a**  $\text{SO}_3^{2-}$ ,  $\text{NO}_3^-$       **B**  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$       **C**  $\text{SO}_3^{2-}$ ,  $\text{NO}_2^-$       **D**  $\text{SO}_4^{2-}$ ,  $\text{NO}_2^-$
- 3 The structures of all the negative atomic groups which you have studied include .....
- a** hydrogen element      **B** oxygen element.      **C** nitrogen element      **D** sulphur element.
- 4 The molecular formula of hydrochloric acid is .....
- a**  $\text{HCl}$       **B**  $\text{HClO}$       **C**  $\text{HClO}_3$       **D**  $\text{NaCl}$
- 5 The correct name of  $\text{H}_2\text{SO}_4$  acid is.....
- a** sulphuric acid      **B** hypochloric acid      **C** sulphurous acid      **D** hypochlorous acid
- 6 The correct formula for an oxyacid is.....
- a**  $\text{H}_2\text{O}_3\text{S}$       **B**  $\text{H}_2\text{S}$       **C**  $\text{H}_2\text{SO}_3$       **D**  $\text{SO}_3\text{H}$
- 7 Acids can contain the following atomic groups, except .....
- a** carbonate group      **B** sulphate group  
**C** nitrate group      **D** hydroxide group
- 8 Which of the following substances are acids ?
- a** Lemon and baking soda.      **B** Ketchup and grapes  
**C** Soap and toothpaste      **D** Detergents and ketchup
- 9 All the following acids are strong, except.....
- a** nitric acid      **B** acetic acid      **C** sulphuric acid      **D** hydrochloric acid
- 10 Each of the following is a weak electrical conductor, except .....
- a** ammonium hydroxide      **B** sulphurous acid      **C** sodium hydroxide      **D** nitrous acid

11 The compound which is used in antacids is.....

- a**  $\text{MgCl}_2$       **b**  $\text{Mg}(\text{OH})_2$       **c**  $\text{H}_2\text{CO}_3$       **d**  $\text{NaCl}$

12 Among the basic oxides is.....

- a**  $\text{SO}_2$       **b**  $\text{SO}_3$       **c**  $\text{NO}_2$       **d**  $\text{Na}_2\text{O}$

13 All the following are harmful impacts of acid rains, except .....

- a** destruction of forests      **b** destruction of the human digestive system.  
**c** corrosion of buildings      **d** death of aquatic organisms

2 Complete the following statements :

1 .....group has a positive charge, while the charge of..... group is -3

2 The molecular formula of an acid begins with the symbol of ..... cation, while the molecular formula of an alkali ends with the symbol of..... anion.

3 Hydrogen cation combines with sulphite anion to form an acid known as ..... with the molecular formula .....

4 The compound  $\text{HI}$  in its gaseous state is known as ..... , while its name in its solution form is .....

5 Hydrobromic acid is composed of ..... cation and.....anion

6 The molecular formula of an acid begins with the symbol of ..... cation, while the molecular formula of an alkali ends with the symbol of..... anion.

7 The gas ..... dissolves in water forming..... cations which are responsible for the properties of acids and  $\text{Cl}^-$  anions.

8 The dissolution of.....oxides in water forms acids, while the dissolution of ..... oxides in water forms alkalis.

9 .....is a strong alkali, while ..... is a weak acid.

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 All nonmetallic element ions end with the suffix (- ate). ☐
- 2 The bicarbonate and nitrate groups are similar in the number of atoms and the charge. ☐
- 3 The stomach secretes lactic acid which participates in the food digestion. ☐
- 4 Milk of magnesia contains MgO ☐
- 5 When calcium oxide dissolves in water and two litmus strips are placed in the solution, one of them turns purple. ☐
- 6 Sulphur oxides dissolve in atmospheric water vapour, forming basic rains that cause the corrosion of buildings. ☐
- 7  $S^{2-}$  anions in  $H_2S$  acid solution are responsible for its acidic properties. ☐
- 8 When lithium hydroxide dissolves in water, the percentage of  $OH^-$  cations in the solution increases. ☐

3 Write the chemical formula for each of the following compounds:

- |                          |                       |
|--------------------------|-----------------------|
| (1) Hydrobromic acid.    | (2) Nitric acid.      |
| (3) Hydrosulphuric acid. | (4) Carbonic acid.    |
| (5) Lithium hydroxide.   | (6) Sodium hydroxide. |

3 State the importance of each of the following in the human body :

- 1 Hydrochloric acid: .....
- 2 Lactic acid : .....
- 3 Milk of magnesia : .....

7 State one difference between each of the following:

- 1 The nitrite group and the sulphite group. :
- 2 Nitric acid and nitrous acid. :
- 3 Sodium hydroxide and ammonium hydroxide. :

## Lesson Three

## NOTES

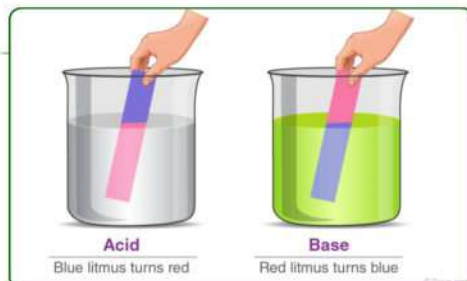
- To differentiate between **acidic**, **alkaline**, and **neutral** substances in a laboratory, we use chemical substances **called indicators**

## Indicators

special substances that change color depending on whether the substance is acidic, alkaline, or neutral.

## Example:

**Litmus:** is an indicator that becomes red in the presence of acids and blue in the presence of alkali.



## How Do Indicators Work?

## Acidic Substances:

- Acids release **H<sup>+</sup> ions** when dissolved in water.
- These substances turn the indicator, such as litmus, **to a red color**.

Alkaline Substances  
(Bases)

- Alkalis, like sodium hydroxide (NaOH), release **OH<sup>-</sup> ions**.
- They turn the indicator, such as litmus, **to a blue color**.

## Neutral Substances:

- A substance that **neither** releases H<sup>+</sup> nor OH<sup>-</sup> ions in a solution is neutral.

## Distilled water

- is an example of a neutral substance.
  - It **does not** change the color of a litmus strip
- because the number of H<sup>+</sup> ions is equal to the number of OH<sup>-</sup> ions.



## Why Should We Use Indicators?

Some acids and alkalis are dangerous (e.g., burning or caustic), so it is important **to never taste, smell, or touch** chemicals without the teacher's permission.

## example

when concentrated **sulphuric acid** is added to **sugar**, it turns **black (charred)**, showing the chemical reaction and danger.

Sugar Dehydration



## Safety First:

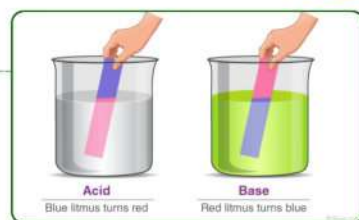


## Litmus Paper

Litmus is a simple indicator that can differentiate between acidic and alkaline solutions

### However

litmus **cannot differentiate** between **strong and weak acids**  
→ because it changes color the same way for both.

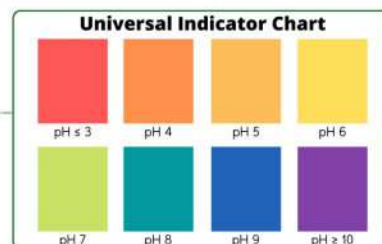


So we use :



## Universal Indicator

- **is a more advanced indicator** that can not only show whether a substance is acidic or alkaline but also **indicate the strength of the acid or alkali**.
- It changes color across a wide range, giving a detailed reading of the solution's pH.



### Summary

- **Indicators** : help us differentiate between acidic, alkaline, and neutral substances.
- **Litmus paper** : changes color based on the pH of the substance (red for acids, blue for alkalis).
- **Universal Indicator** : is more detailed and can show the strength of acids and alkalis.
- **Safety**: Chemicals like acids and alkalis can be harmful, so proper handling and using indicators are crucial for safety in the lab.

## Testing the Acidity and Basicity of Gases

◆ To determine whether a gas is acidic or basic, **we use :**

**indicator strips**

- but they **must be wet with water** during testing.

→ because indicators only work in an aqueous (water-based) medium, and gases must dissolve in water for the test to be effective.

**1 Acidic Gases (Carbon Dioxide  $\text{CO}_2$ )**

- Dissolve in water to form acids.
- Turn blue litmus paper **red** (indicating acidity).

**2 Basic Gases (Ammonia  $\text{NH}_3$ )**

- Dissolve in water to form bases.
- Turn red litmus paper **blue** (indicating alkalinity).

**Behavior of Different Gases with Indicators:****3 Neutral Gases**

Hydrogen  $\text{H}_2$ , Oxygen  $\text{O}_2$ , Nitrogen  $\text{N}_2$

- Do **not affect** the indicator
- because they do not form acidic or basic solutions.

**4 Chlorine Gas ( $\text{Cl}_2$ ):**

- **removes the color** of **both** red and blue litmus paper.
- This is due to its strong oxidizing properties.

**Real-Life Application:****The Effect of Soil pH on Hydrangea Flowers**

◆ The color of Hydrangea flowers changes depending on the pH of the soil:



**In acidic soil**

the flowers turn **red**.

**In alkaline soil**

the flowers turn **blue**.



Acidic soil is treated by **adding basic substances** to it, such as : **calcium hydroxide  $\text{Ca(OH)}_2$** .

**Scientific Concept: Cause and Effect**

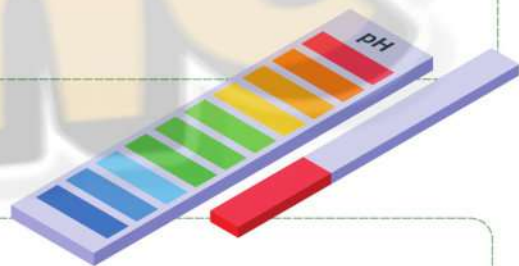
- The **color change** of indicators is directly related to the **type of solution** (acidic, basic, or neutral).
- The **pH of the soil** affects the **color of flowers** and determines which plants **can grow successfully** in a given environment.

**Potential of Hydrogen (pH) and Acidity Measurement****Why Do Different Substances Have Different Acidity?**

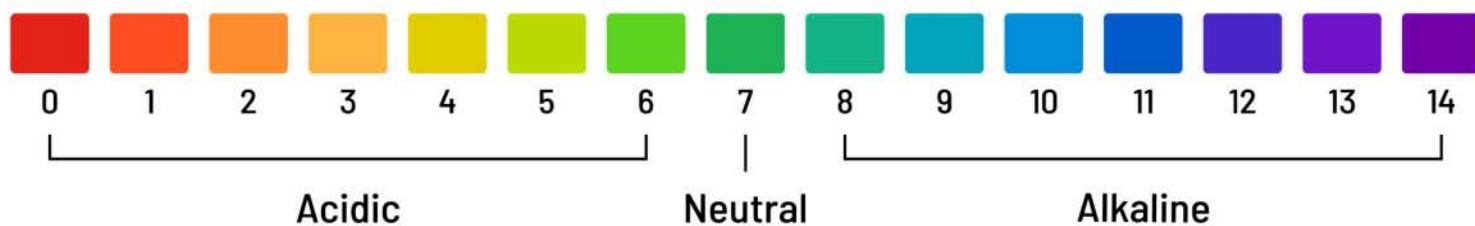
- The **acidity of tomatoes** is different from that of **lemon**,  
→ meaning some substances are more acidic than others.

**But how can we measure acidity accurately?**

- Scientists use the **pH scale**, which stands for "Potential of Hydrogen",  
→ to determine whether a solution is acidic, basic, or neutral.

**pH Scale**

- **The pH** scale ranges from **0 to 14**.
- **Neutral solutions** (like distilled water) have a **pH of 7**.
- **Acidic solutions** have a pH **less than 7** (the closer to 0 the stronger the acid).
- **Basic (alkaline) solutions** have a pH **greater than 7** (the closer to 14, the stronger the base).



pH Value	Solution Type	Examples
0 - 3	Strong Acid	Battery acid, Stomach acid
4 - 6	Weak Acid	Vinegar, Tomato juice
7	Neutral	Distilled water
8 - 10	Weak Base	Baking soda solution
11 - 14	Strong Base	Bleach, Drain cleaner



### Soren Sorensen :

- Soren Sorensen was a Danish chemist.
- In 1909, he developed the pH scale to help scientists differentiate between acidic, basic, and neutral solutions.
- His work is essential for modern chemistry, biology, and environmental science.

## How to Measure pH?

### 1 Using a pH Meter (Accurate Measurement)

- **A pH meter** is an electronic device that measures the exact pH of a solution.
- **It provides the most precise and reliable results.**



### 2 Using Universal Indicator Strips (Approximate Measurement)

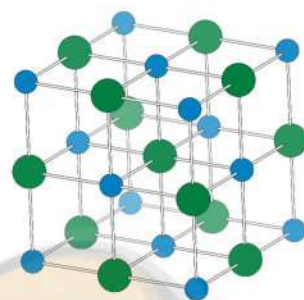
1. **Universal indicator strips** are dipped into a solution.
2. The strip changes color depending **on the pH**.
3. The color is then compared to a pH color chart to determine the solution's approximate pH value.

## Summary

- The pH scale helps classify substances as acidic, neutral, or basic.
- **Acids** have pH **less than 7**, **bases** have pH **greater than 7**, and **neutral** substances have **pH 7**.
- **pH meters** provide **accurate** results, while **universal indicator** strips offer an **easy and quick estimation** of pH levels.

## Salts

## Definition , Formation , and Properties

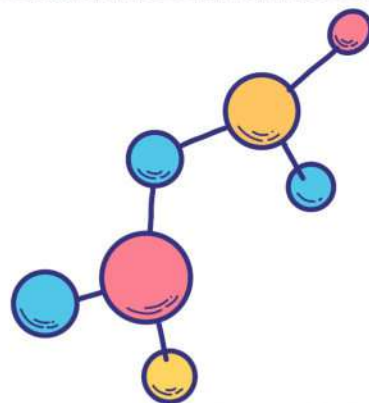


## What Are Salts?

- **Salts** : are a type of chemical compound that differs from oxides, acids, and alkalis.
- Most salts are **ionic compounds** formed when acids react with alkalis.  
→ This reaction **produces** a **salt and water** as **byproducts**.

## How Are Salts Formed? A salt molecule is created by combining:

1. A **metal ion** (from an alkali) with a **nonmetal ion** (from an acid), except oxide ions ( $O^{2-}$ ).
2. An **ion from one element** with an **ion** from a **polyatomic group**, except hydroxide ions ( $OH^-$ ).
3. **Two polyatomic ions** combining together.



## Important Rule in Writing Salt Formulas:

1. When a polyatomic group repeats in a chemical formula, it is written **inside brackets**, with its number of repetitions below it.
2. The name of a salt always **starts with the cation name** (positive ion) followed by the **anion name** (negative ion).

### Example

#### Calcium Hydroxide

- Chemical formula:  $\text{Ca}(\text{OH})_2$

Explanation:

- The hydroxide ion ( $\text{OH}^-$ ) is a **polyatomic ion**.
- Since two hydroxide ions are present, they are written **inside brackets** ( $\text{OH}$ ), with <sub>2</sub> outside to indicate repetition.
- Name of the salt: Calcium hydroxide ( $\text{Ca}^{2+}$  is the cation,  $\text{OH}^-$  is the anion).

#### Aluminum Nitrate

- Chemical formula:  $\text{Al}(\text{NO}_3)_3$

Explanation:

- Nitrate ion ( $\text{NO}_3^-$ ) is a **polyatomic ion**.
- Since three nitrate ions are needed to balance the aluminum ion ( $\text{Al}^{3+}$ ), they are placed **inside brackets** ( $\text{NO}_3$ ) with <sub>3</sub> outside.
- Name of the salt: Aluminum nitrate ( $\text{Al}^{3+}$  is the cation,  $\text{NO}_3^-$  is the anion).

## Properties of Salts

### 1 Different Colors

(1) Some salts are white,

such as : zinc sulfate ( $\text{ZnSO}_4$ ) and sodium carbonate ( $\text{Na}_2\text{CO}_3$ ).

(2) Others are colored ,

such as : blue copper sulfate ( $\text{CuSO}_4$ ) and green nickel chloride ( $\text{NiCl}_2$ ).

### 2 pH Variation

- The pH of salt solutions depends on **the type of acid and alkali that formed the salt.**



**3 Solubility in Water**

**(1) Some salts are soluble in water, forming clear solutions.**

**Examples:**

- Copper sulfate ( $\text{CuSO}_4$ )
- Nickel chloride ( $\text{NiCl}_2$ )
- All sodium, potassium, and ammonium salts

**(2) Some salts are insoluble or sparingly soluble in water.**

**Examples:**

- Silver chloride ( $\text{AgCl}$ )
- Calcium sulfate ( $\text{CaSO}_4$ )
- Most carbonate salts (except sodium, potassium, and ammonium carbonates)

**The Dead Sea's High Salinity**

- has the **highest salt concentration** in the world, almost **10 times** saltier than the Red Sea.
- The high salt content **increases the density of water**, making it impossible for people to sink.

**Summary**

- Salts are ionic compounds formed from acid-alkali reactions.
- They differ in color, solubility, and pH.
- The Dead Sea's high salinity increases water density, preventing drowning.

## words of the lesson

indicators	المؤشرات	dipped into	مغموس في
Distilled water	الماء المقطر	estimation	تقدير
neutral	محايد	byproducts	نواتج ثانوية
Sugar Dehydration	نزع الماء من السكر	polyatomic group	مجموعة متعددة الذرات
Litmus Paper	ورق عباد الشمس	Variation	تباين
differentiate	تمييز	Solubility	الذوبانية
crucial	حاسم / ضروري	concentration	التركيز
proper handling	التعامل السليم	amphoteric	متعدد
indicator strips	شرائط المؤشر		
aqueous	مائي		
accurately	بدقة		
precise	دقيق		
reliable	موثوق		

## Questions

## 1 Choose the correct answer:

1 A red litmus strip is placed in solution (1), so no change in colour occurs, when it is placed in solution (2), it becomes blue. Which of the following is correct ?

- A** Solution (1) : Neutral, Solution (2) : Acidic.      **B** Solution (1): Acidic, Solution (2): Neutral.  
**C** Solution (1) Acidic, Solution (2) : Alkaline.      **D** Solution (1) : Alkaline, Solution (2): Acidic.

2 The colour of the universal indicator is the same in both .....

- A** tomato juice and hydrochloric acid.  
**B** distilled water and sodium chloride solution.  
**C** tomato juice and sodium hydroxide solution.  
**D** distilled water and hydrochloric acid.

3 All the following are ions that form salts, except.....

- A**  $\text{OH}^-$       **B**  $\text{Cl}^-$       **C**  $\text{NH}_4^+$       **D**  $\text{NO}_3^-$

4 All the following are properties of solid sodium carbonate salt, **except** .....

- A** it dissolves in water.  
**B** PH of its solution is higher than 7  
**C** its colour is white.  
**D** it conducts electricity.

5 pH value of a solution is changed from 8 to 5, that means it was. ....

- A** acidic and becomes alkaline.  
**B** acidic and becomes neutral.  
**C** alkaline and becomes neutral.  
**D** alkaline and becomes acidic.

- 6 If a solution does not change the color of either red or blue litmus paper, the solution is.....  
 a acidic                      b neutral                      c basic                      d Strongly acidic
- 7 What happens to red litmus paper when dipped in a basic solution?  
 a It turns green.                      b It stays red.                      c It turns blue.                      d It becomes colorless.
- 8 What does blue litmus paper indicate when it turns red?  
 a The solution is basic.                      b The solution is neutral.  
 c The solution is acidic.                      d The solution is amphoteric
- 9 When a litmus paper is placed in a solution containing hydroxide ions, its color changes to.....  
 a blue                      b red                      c purple                      d dark

**2 Complete the following statements :**

- 1 .....are soluble in water, forming clear solutions.
- 2 .....are sparingly soluble in water
- 3 The name of a salt always starts with ..... followed by the .....
- 4 when two polyatomic ions combining together ..... formed
- 5 Neutral solutions (like distilled water) have a pH of .....
- 6 The pH of the soil affects the ..... of flowers
- 7 .....removes the color of both red and blue litmus paper.
- 8 ..... is an indicator that becomes red in the presence of acids and blue in the presence of alkali

**3 put ( ✓ ) or ( x ) for each statement , with correction:**

- 1 Most salts are ionic compounds formed when acids react with alkalis ☐
- 2 The hydroxide ion ( $\text{OH}^-$ ) is a polyatomic ion ☐
- 3 Acids have pH more than 7, bases have pH less than 7 ☐
- 4 universal indicator strips offer an difficult , complex estimation of pH levels. ☐
- 5 The acidity of tomatoes is different from that of lemon ☐
- 6 The color change of indicators is directly related to the type of solution ☐
- 7 Acidic Gases dissolve in water to form bases. ☐

**3 Write the chemical formula for each of the following compounds:**

- |                       |                      |
|-----------------------|----------------------|
| (1) Copper sulfate    | (2) Silver chloride  |
| (3) Nickel chloride   | (4) sodium carbonate |
| (5) Calcium Hydroxide | (6) Aluminum Nitrate |

**3 State the importance of each of the following in the human body :**

- 1 Indicators : .....
- 2 Litmus Paper : .....
- 3 Soil pH : .....

**7 State one difference between each of the following:**

- 1 Acidic solutions - alkaline solutions
- 2 Litmus Paper - Universal Indicator



# UNIT( 2 )

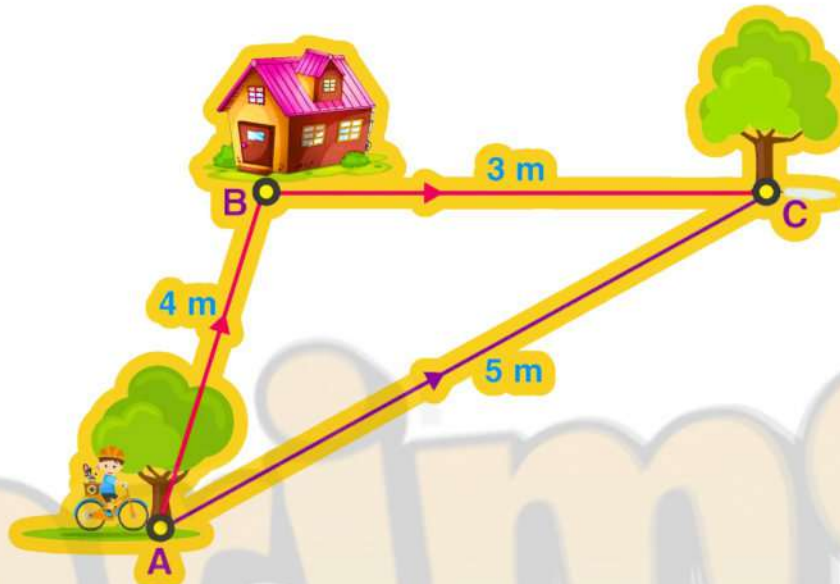
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Energy and its  
Applications

Potential Energy / Distance / and Displacement

1 Distance and Displacement

Imagine a camel straying in the desert 🐫. Its owner follows its footprints in the sand to track its movement path. This example helps us understand two key concepts: **distance** and **displacement**.



Distance (d)

- **Definition:** The total length of the path an object travels from start to end.
- **Example:** A boy moves 4 m + 3 m to reach to the tree ( c ) →  
Total distance = 7 m.

Displacement (s)

- **Definition:** The shortest straight path connecting the starting point to the endpoint **in a constant direction**.
- **Example:** A boy moves from (A) to ( C ) in straight line (shortest straight path) →  
Displacement = 5 m.

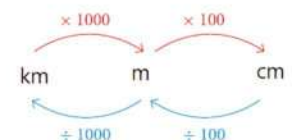
Path of Movement

is the set of points an object passes through during motion.

Key Differences

- ✓ Distance considers the total path traveled, while displacement measures the direct shortcut.
- ✓ Both are measured in meters (m), kilometers (km), or centimeters (cm).
- ✓ Distance : (no direction) / displacement (has direction)

To provide understanding only



Speed (v) and Time (t)

Speed (v)

• **Definition:** The distance covered per unit time.

• **Formula :**

$$v = \frac{\text{distance (d)}}{\text{time (t)}}$$

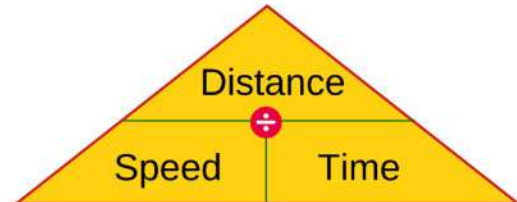
**Units:**

- ✓ Meter per second (m/s)
- ✓ Kilometer per hour (km/h)

Time (t)

**Units:**

- ✓ Seconds (s)
- ✓ Minutes (min)
- ✓ Hours (h)



NOTES

- Exceeding speed limits increases road accidents. 🚗

QUIZ  
TIME

- ◆ Calculate the speed of an object that covers a distance of 8 m in 2s

.....

.....

- ◆ An object moves at a speed of 20 m/s, Calculate the distance that the object travels after one minute.

.....

.....

- ◆ The opposite figure illustrates the path of an object from point (A) to point (B) over 24 seconds.

Calculate the following:

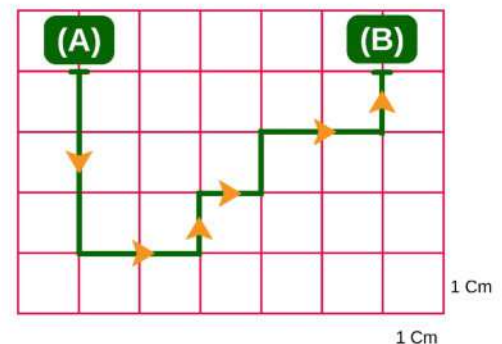
1. Distance.
2. Speed.
3. (Displacement.

.....

.....

.....

.....



















Work (W) and Force (F)

Work (W)

The amount of energy required to move an object through a certain displacement in the same direction of the force which acts on it.

◆ **Formula :** Work (W) = Force (F) × Displacement (s)

Tha case	Direction of the acting force	Direction of the object's motion	Possibility of doing work	Explanation
				Because the direction of the force's effect is in the same direction of the motion
				
				Because the object is at rest
				Because the direction of the force's effect is perpendicular to the direction of motion

Key Observations

✓ If there is no displacement, no work is done!

Example: A person pulling a tree without moving it → No work is done because displacement = 0.

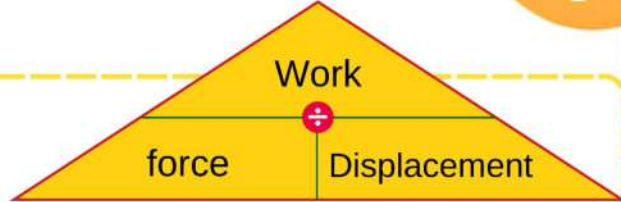
✓ If force is applied at an angle ( $\neq 90^\circ$ ), work is still done.

◆ Units of Work, Force, and Displacement

• 1kJ = 1000 J

Quantity	Unit
Work (W)	Joule (J) or Kilojoule (KJ)
Force (F)	Newton (N)
Displacement (s)	Meter (m)

QUIZ  
TIME



- ◆ A person pushes an object with a force of 20 N, Moving it in a Straight line over a distance equals 50 m in the same direction of the force. Calculate the amount of work done.  
.....  
.....
- ◆ To displace a box over 2 m distance, it requires a work equals 400 J Calculate the force required to perform this work.  
.....  
.....

Scientific Processes – Controlling Variables

➔ In scientific experiments, controlling variables is essential to study causes and effects.

Type of Variable	Definition	Example: Plant Growth Experiment
Independent Variable (Cause)	The factor changed in an experiment	Amount of water used daily
Dependent Variable (Effect)	The factor measured based on changes	Growth of the plant
Controlled Variables	Factors kept constant for accuracy	Type , number of seeds - soil , amount of light

✓ Example:

If different types of tissue paper are tested, the independent variable is the paper type, and the dependent variable is the amount of water absorbed.



## Energy (E) – The Ability to Do Work

Energy is measured in **Joules (J)**.

As energy **increases**, the ability to perform work **increases**.

### Forms of Energy

#### 1 Potential Energy (PE)

#### 2 Kinetic Energy (KE)

in lesson (2)

### 1 Potential Energy (PE)

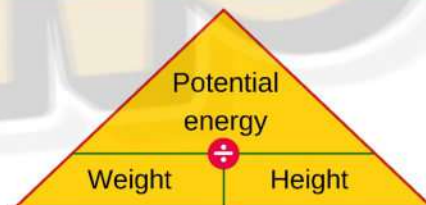
#### Potential energy

- The energy stored in an object due to its position or condition.
- The energy stored in an object as a result of the work done on it.

#### Formula :

Potential energy (PE) (=) Weight of the object (w)  $\times$  Height (h)

Potential energy (PE) (=) Mass (m)  $\times$  Gravitational field intensity (g)  $\times$  Height (h)



#### NOTES

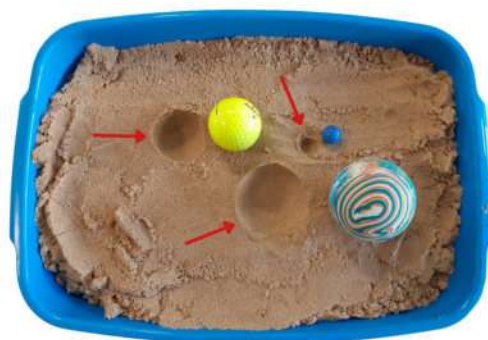
- Weight of the object (w) = Mass (m)  $\times$  Gravitational field intensity (g)
- Gravitational field intensity (g)  $\approx$  10 N/kg

### Factors Affecting Potential Energy

#### 1 Object's Weight (w)

##### Experiment: Effect of Weight on Potential Energy

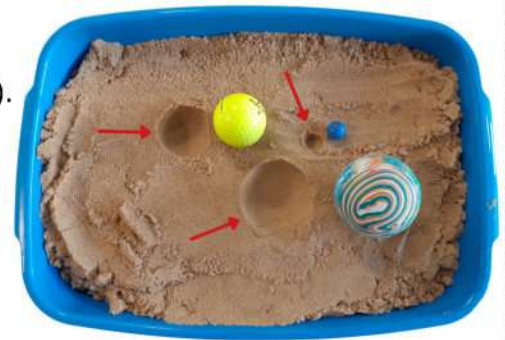
- ✓ Drop marbles of different weights from the same height onto sand.
- ✓ Observation: **Heavier marbles** create **deeper craters** in the sand.
- ✓ **Conclusion: More weight  $\rightarrow$  More potential energy.**
- ✓ **Controlled Variables:** Height, amount of sand.
- ✓ **Independent Variable:** Weight of the marbles.
- ✓ **Dependent Variable:** Depth of the crater.



## 2 Object's Height (h)

### Experiment: Effect of Height on Potential Energy

- ✓ Drop the same marble from different heights (50 cm, 75 cm, 100 cm).
- ✓ Observation: Higher drop → Deeper crater.
- ✓ **Conclusion: More height → More potential energy.**
- ✓ **Controlled Variables:** Weight of the marble, amount of sand.
- ✓ **Independent Variable:** Height of the marble.
- ✓ **Dependent Variable:** Depth of the crater.



- ◆ Calculate the potential energy of an object its mass 6 kg located at a height of 3 m above the ground  
.....  
.....
- ◆ Calculate the weight of an object whose potential energy becomes 88 J when it is lifted to a height of 41 m from the ground  
.....  
.....
- ◆ Calculate the height of an object above the ground, given that its weight is 4 N and its potential energy is 10 J  
.....  
.....

### Summary : Key Takeaways on Potential Energy

- ✓ Objects **above** ground have potential energy.
  - **Factors affecting PE:**
    1. Weight of the object (w) → **More weight = More PE.**
    2. Height above ground (h) → **Higher position = More PE.**
- ✓ If weight **doubles** with constant height → PE **doubles**.
- ✓ If height is **halved** with constant weight → PE **halves**.
- ✓ If weight **doubles** & height **halves** → PE remains constant.

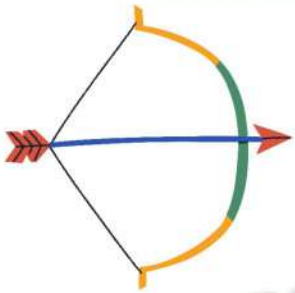
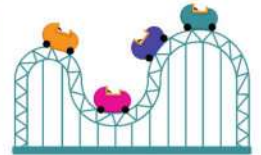


## NOTES

- ✓ Chemical energy in food and fuel is a form of potential energy stored in chemical bonds.
- ✓ This energy is released and converted into kinetic energy during chemical reactions.

## Real-Life Applications of Potential Energy

- ✓ Water stored in a dam has high PE → Converts into kinetic energy to generate electricity.
- ✓ Stretched bowstring has PE → Releases energy to launch an arrow.
- ✓ A roller coaster at the highest point has PE → Converts to kinetic energy when descending.



## The most important points of the lesson



1. **Distance** is the **total path** traveled, while **displacement** is the **shortest straight path**.
2. **Speed** measures **how fast an object moves**.
3. Work **is done** when a force **moves an object in the same direction**.
4. **Energy** is the **ability to do work**, and **potential energy** is **stored energy** due to height or weight.
5. **Potential energy** depends on (1) **weight** and (2) **height**.
6. In real life, potential energy plays a role in electricity, sports, and natural phenomena.



## words of the lesson

Distance	مسافة
Displacement	إزاحة
Path of movement	مسار الحركة
Straight path	مسار مستقيم
Measuring unit	وحدة قياس
Speed	سرعة
Exceed	تجاوز
Speed limits	السرعات المقررة
Work	الشغل
Force	القوة
Controlling the variables	ضبط المتغيرات المتغير المستقل
Independent variable	المتغير التابع
Dependent variable	المتغير الضابط
Controlled variable	الطاقة
Energy	طاقة الوضع
Potential energy	حفرة
Crater (hole)	

Questions



EL-MOASSER

1 Choose the correct answer:

1 The potential energy of an object depends on .....

- ☐ a its weight and speed. ☐ b its weight and mass.  
☐ c its speed and height above the ground. ☐ d its weight and height above the ground.

2 Each of the following is a unit of measuring distance, except .....

- ☐ a cm ☐ b km ☐ c kg ☐ d m

3 If a student walks to his school, which is 900 meters away from home, at a speed of 5 m/s, how long will it take him to reach school?

- ☐ a 30s ☐ b 3 min ☐ c 180 min ☐ d 0.5h

4 Work is measured in .....

- ☐ a Joule. ☐ b Newton. ☐ c watt. ☐ d kilometre.

5 What is the amount of work done by a student pushing the wall of his room with a force of 500 N?

- ☐ a zero. ☐ b 225 J ☐ c 500 J ☐ d 1000 J

6 65 N force acts on a stationary object causing it to move for a distance of 10 m in the same direction of the force, the work done is.....

- ☐ a 0.65 J ☐ b 6.5 J ☐ c 65 J ☐ d 650 J

7 When the force acting on an object is doubled with constant displacement the work done will .....

- ☐ a decrease to half. ☐ b increase to four times its value.  
☐ c be doubled. ☐ d decrease to quarter.

8 What is the quantity which has the same unit of measurement as force?

- ☐ a Energy ☐ b Displacement ☐ c Speed ☐ d Weight

9 The potential energy of an object increases when.....

- ☐ a its speed increases. ☐ b its weight increases.  
☐ c its height decreases. ☐ d its weight decreases.

- 10 The potential energy of an object is equal to zero .....
- a** at maximum height. **B** at the ground level.  
**C** when its mass increases. **D** when its speed increases.
- 11 A work equals 150 kJ is done to lift an object its mass is 50 kg to a height h from the surface of the ground. The height h equals .....
- a** 30 km **B** 300 m **C** 1500 m **D** 1500 km
- 12 Which of the following shows the relationship between an object's potential energy at the top of a mountain (position 1) and its potential energy at ground level (position 2)?
- a**  $PE(1) > PE(2)$  **B**  $PE(1) = PE(2)$  **C**  $PE(1) < PE(2)$  **D**  $PE(2) - PE(1) = 0$
- 13 Each of the following expresses physical quantities, with their correct measuring units, except for.....
- a** speed (m/s). **B** work (N.m). **C** force (N). **D** energy (N/m)
- 14 Which of the following describes an object moving at a speed of 60 km/h?
- a** It covers 30 min half a minute  
**B** It covers 16.67 m in one second.  
**C** It covers 100 m in one minute.  
**D** It covers 2.43 m in one second.
- 13 The chemical energy stored in the food we eat is considered as a type of.....
- a** kinetic energy **B** potential energy **C** electrical energy **D** sound energy.

2 Complete the following statements :

- 1 Force does not perform work when its direction of effect is ..... the direction of motion, or when the object remains .....
- 2 If a force of 200 N acts on a car and does not move it from its position, the work done on it equals .....
- 3 If the work done on a box to displace it 2 m equals 400 J, then the magnitude of the force required to do this work equals.....

- 4 Energy has various forms, including .....and.....
- 5 Unit of measurement of energy is ..... which is the same unit of measurement of .....
- 6 The potential energy of an object depends on..... and.....
- 7 The mass is estimated in ..... while the weight is estimated in.....
- 8 The chemical energy present in the car fuel is the ..... energy stored in the chemical bonds and is converted into ..... energy when a chemical reaction occurs.
- 9 The potential energy of an object depends on..... and.....
- 10 When you lift your bag, the ..... is converted into .....stored in the bag.
- 11 Gravitational field intensity is measured in.....
- 12 The potential energy of an object found on the ground equals .....

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 The product of the speed of the object multiplied by the time equals the work. ☐
- 2 Speed is measured in km/h when the distance is measured in m and the unit of time is s. ☐
- 3 A train that covers a distance of 200 km in 150 min has a speed of 90 km/h. ☐
- 4 The speed of moving an object increases when the distance covered in the same time increases. ☐
- 5 A force does work when its direction of effect is perpendicular to the direction of motion. ☐
- 6 When a robot exerts a force of 10 N on 2 bricks to lift them vertically for 3 m, it performs work equal to 40 J. ☐
- 7 The variable that is changed during the experiment is known as the independent variable. ☐

4 Choose from column (B) what suits it in column (A), and rewrite the statements:

(A) Physical quantity	(B) Unit of measurement
(1) Energy	(1) J
(2) Mass	(2) kg
(3) Weight	(3) N
(4) Height	(4) m
(5) Speed	(5) m/s
(6) Earth's gravitational field intensity	(6) N/kg

(1) ..... - (2) ..... - (3) ..... - (4) ..... - (5) ..... - (6) .....

5 When does each of the following occur :

- 1) The distance travelled equals the magnitude of the displacement.
- 2) The speed of the object equals the distance it covers.
- 3) The force performs work.
- 4) The force does not do work.
- 5) The potential energy of an object equals zero.

6 Choose the odd word (or phrase) out, then mention the relation between the rest.

- 1) Time / Mass / Speed / Distance.
- 2) Work / Force / Displacement / Kinetic energy.
- 3) Potential energy / Square of the speed / Height / Weight of the object.
- 4) Distance / Height / Speed / Displacement.
- 5) Newton / Force / Joule / Kilogram.

7 State the mathematical relation that relates between:

- (1) Speed and distance.
- (2) Work and force.
- (3) Potential energy of an object and its height above the ground.
- (4) Weight of the object and its mass.
- (5) Potential energy and the strength (intensity) of the gravitational field.

**8 Give reasons for each of the following:**

1. The difference in the value of distance compared to the value of displacement for the same moving object, even though they have the same unit of measurement.
2. A person pushing against a wall does not perform work.
3. A person pushing a shopping trolley performs work.
4. The role of fuel within a car is similar to the role of food within a living organism.

**9 What happens in the following cases :**

1. Cars exceed the permitted speed limits on the road.
2. Exerting a suitable force on a stationary object (an object at rest).
3. The weight of the object is doubled with constant height "Regarding its potential energy".
4. The vertical distance that the object is lifted above the ground decreases to half with constant mass "Regarding its potential energy".

**10 Variant problems :**

1. A car is moving at a certain speed to cover a distance of 180 m in a time of 30 s , Calculate the speed of this car.
2. A student took 15 min to travel from his home to school moving at a speed of 3 m/s , Calculate the distance which the student travelled .
3. Calculate the work done when a force of 1000 N is applied to move an object over 50 m in the same direction of the force.
4. Moving an object for 3 m requires work equals 2600 J , Calculate the force required to perform this work.
5. If work of 500 J is done to move an object over a certain displacement with a force of 25 N , Calculate the displacement that the object covers.
6. An object with a mass of 10 kg is placed at a height of 4 m above the ground , Calculate:
  - (1) The potential energy of the object.
  - (2) The potential energy of the object when its weight is doubled and its height decreases to half. / What do you conclude from this?

## Kinetic Energy and Mechanical Energy

### Kinetic Energy



### 1 Introduction to Kinetic Energy

When a book is lifted to a shelf, the **work done on it** is stored as **potential energy**. However, when the book **falls**, this stored energy **is converted into** motion energy, known as kinetic energy (KE).

### Kinetic Energy (KE)

- is the energy an object gains due to its motion.
- is the work done on an object to bring it into motion.

#### • Examples of Kinetic Energy in Daily Life:

( A moving car 🚗 - A rolling ball ⚽ - A flying airplane ✈️ - A flowing river 🌊 )

♦ measuring unit : Joules (J) .

### 2 Factors Affecting Kinetic Energy :

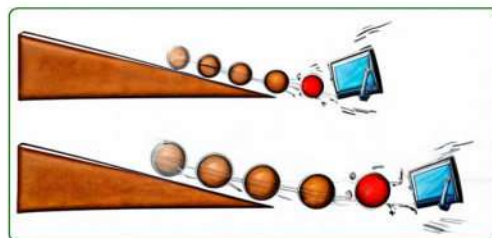
(1) Mass of the Object (m)

(2) Speed of the Object (v)

#### (1) Mass of the Object (m)

##### Experiment: Effect of Mass on Kinetic Energy

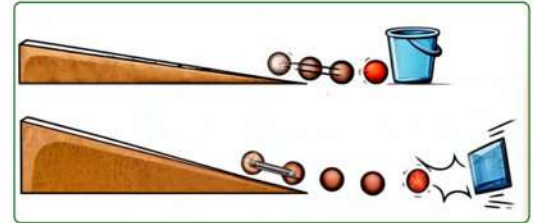
- ✓ A ball is rolled down a ramp to hit an empty bucket.
- ✓ Observation: The **heavier the ball** , the **farther** the bucket moves.
- ✓ **Conclusion: Increasing mass → increases kinetic energy.**
- ✓ **Controlled Variables:** Ramp height (same speed), bucket.
- ✓ **Independent Variable:** Mass of the ball.
- ✓ **Dependent Variable:** Distance the bucket moves.



### (2) Speed of the Object (v)

#### Experiment: Effect of Speed on Kinetic Energy

- ✓ A ball is rolled down a ramp from different heights.
- ✓ Observation: The **higher the ramp**, the **greater the speed**, and the **farther the bucket moves**.
- ✓ **Conclusion: Increasing speed → increases kinetic energy.**
- ✓ **Controlled Variables:** Mass of the ball, bucket.
- ✓ **Independent Variable:** Ramp height (speed of the ball).
- ✓ **Dependent Variable:** Distance the bucket moves.



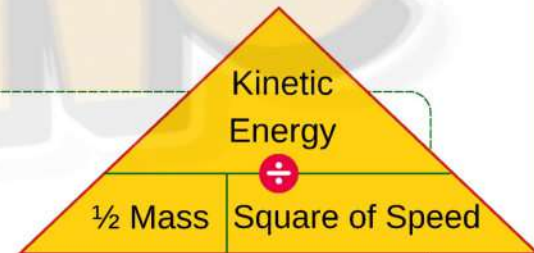
◆ **Formula :** Kinetic Energy (KE) =  $\frac{1}{2} \times \text{Mass (m)} \times \text{Square of the Speed (v}^2\text{)}$

- Where: ✓ KE = Kinetic Energy (Joules) // ✓ m = Mass (kg) // ✓ v = Speed (m/s)



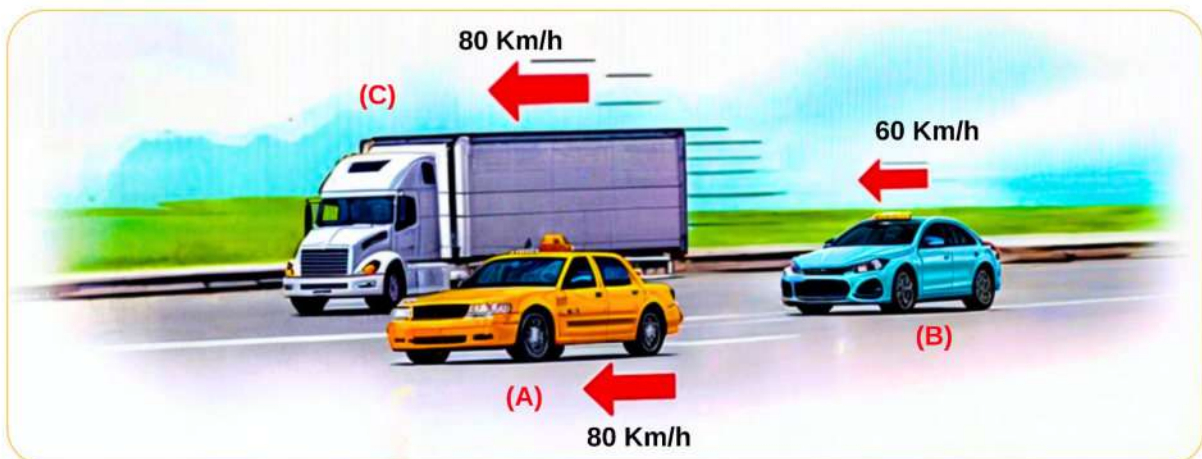
#### Key Observations:

- ✓ If mass is **halved** (constant speed) → KE is **halved**.
- ✓ If speed is **doubled** (constant mass) → KE **increases 4 times**
- ✓ If mass is **halved** and **speed is doubled** → KE **doubles**.
- ✓ If mass is **quartered** and **speed is doubled** → KE **remains constant**.



✓ **Example 1:** Two cars (A and B) have **the same mass**, but A is moving faster  
→ A has more KE and does more work.

✓ **Example 2:** A truck (C) and a car (D) move at **the same speed**, but C is heavier  
→ C has more KE and does more work.





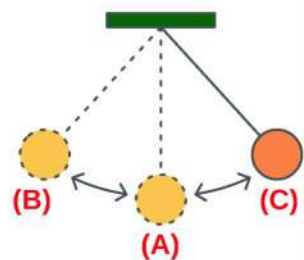
- ◆ Calculate the kinetic energy of a metallic ball its mass is 2 kg, if it moves at a speed of 3 m/s  
.....  
.....
- ◆ Calculate the mass of an object its kinetic energy equals 48 J and its speed is 4 m/s.  
.....  
.....
- ◆ Calculate the speed of an object its mass is 10 kg and has a kinetic energy equals 500 J  
.....  
.....
- ◆ Two objects (X) and (Y), the mass of object (X) is double the mass of object (Y), and the speed of object (X) is half the speed of object (Y).  
Is the kinetic energy of object (X) equal to the kinetic energy of object (Y)? Explain  
.....  
.....  
.....  
.....

Relationship Between Potential and Kinetic Energy

◆ Pendulum Motion as an Example :

→ A pendulum ball swings left and right around a central position (A).

Position	Speed	Kinetic Energy (KE)	Potential Energy (PE)
At highest points (B & C)	Zero	Zero	Maximum
Passing through (A)	Maximum	Maximum	Zero



- NOTES**
- When potential energy decreases , kinetic energy increases (and vice versa).
  - Total energy remains constant.

## Energy Conversion in a Pendulum

### 1. Lifting the ball to position (B):

- Work is done on the ball, storing energy as potential energy (PE).

### 2. Releasing the ball from (B) towards (A):

- PE gradually converts into kinetic energy (KE) as the ball moves downward.
- PE decreases, while KE increases.

### 3. At (A) (lowest point):

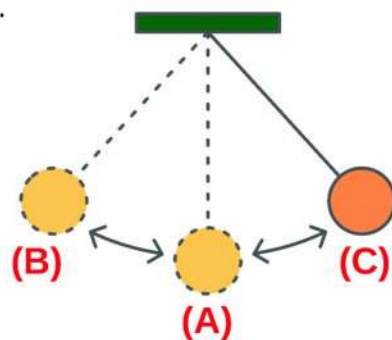
- The ball's speed is at its maximum, meaning KE is at its highest.
- PE is zero because it is at the lowest position.

### 4. Moving from (A) to (C):

- As the ball rises, KE decreases, and PE increases again.

### 5. At (C) (highest point):

- The ball momentarily stops, making KE zero.
- PE is at its maximum before the ball swings back.



## Mechanical Energy (ME)

### Mechanical Energy

is the sum of potential and kinetic energy in a moving object.

**Formula :** Mechanical energy (ME) = Potential energy (PE) + Kinetic energy (KE)

## Mechanical Energy at Different Positions

Position	KE	PE	Total Mechanical Energy (ME)
At Maximum Height (C)	0	Maximum	ME = PE
At Midpoint (B)	Half PE , Half KE	Half KE , Half PE	ME = KE + PE = 2KE = 2PE
At Original Position (A)	Maximum	0	ME = KE

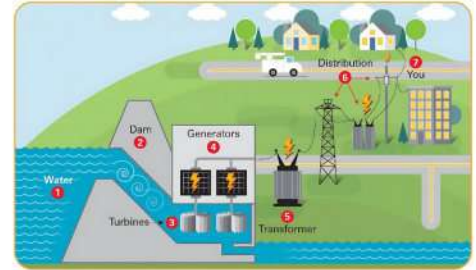
### NOTES

- When an object is thrown upwards, PE increases while KE decreases, but ME remains constant.
- The increase in PE is equal to the decrease in KE.

## Real-Life Applications

### Electricity Generation from the High Dam

- ✓ Water behind the dam has potential energy.
- ✓ When released, it falls and gains kinetic energy.
- ✓ This kinetic energy turns turbines to generate electricity.



### Demolition Ball

- ✓ A heavy ball is lifted, storing potential energy.
- ✓ When released, its KE increases.
- ✓ The impact transfers KE to the building, causing demolition.



## NOTES

### From Medical and Safety Applications :

1. Avoid lifting heavy objects improperly
2. The load should be on the leg muscles, not the back, to prevent spinal injuries.



The most important points of the lesson

- Kinetic energy depends on **mass** and **speed**.
- Speed affects KE more than mass (since  $KE \propto v^2$ ).
- Potential and kinetic energy transform into each other, but **total mechanical energy remains constant**.
- Applications of energy transformations include **electricity generation and demolition**.

Important Notes and Guidelines for Problem Solving

- **At maximum height** → PE is maximum, KE is zero.
- **At original position** → KE is maximum, PE is zero.
- **At any point in motion** →  $ME = PE + KE$  (constant).

Concept	Formula	Factors Affecting It
Kinetic Energy (KE)	$KE = \frac{1}{2} mv^2$	Mass (m), Speed (v)
Potential Energy (PE)	$PE = mgh$	Mass (m), Height (h)
Mechanical Energy (ME)	$ME = PE + KE$	Always constant

- If speed **doubles**, KE **increases 4 times**
- If mass **doubles** (constant speed), KE **doubles**.
- If mass **halves** and speed **doubles**, KE **doubles**.
- Mechanical energy **is always conserved**.



## words of the lesson

Kinetic energy	الطاقة الحركية
Lift	رفع
Drop	إسقاط / سقوط
Ramp	منحدر / مستوي مائل
Bucket	دلو
Original position	الموضع الأصلي
Mechanical energy	الطاقة الميكانيكية
Midpoint	نقطة المنتصف
Gravitational field intensity	شدة مجال الجاذبية
Generation	توليد / إنتاج
The High Dam	السد العالي
Sustainable way	طريقة مستدامة
Demolition	هدم / تدمير

Never  
UP  
Give

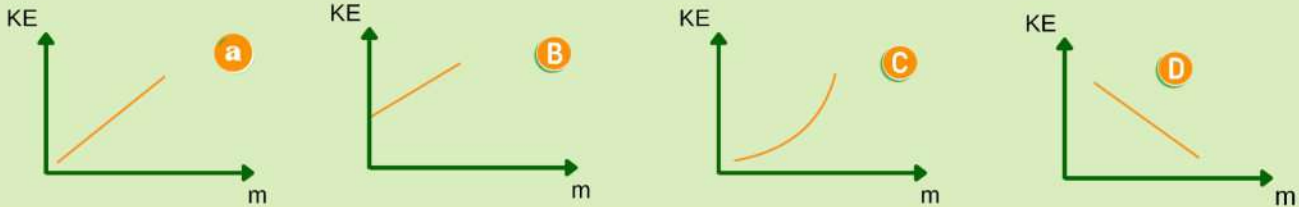
Questions



EL-MOASSER

1 Choose the correct answer:

- 1 The relation between the kinetic energy and the mass for several objects at constant speed is expressed graphically by.....



- 2 The kinetic energy of an object depends on.....

- (a) the weight of the object and its height. (b) the mass of the object and its speed.  
(c) the gravitational field intensity and the speed. (d) distance and time.

- 3 Which of the underlined objects do(es) not possess kinetic energy ?

- (a) A ship sailing in the ocean. (b) A ball thrown upwards.  
(c) A box falling down of stairs. (d) A bag placed on a shelf.

- 4 The kinetic energy of any moving object is determined by the mathematical relation:

- (a)  $mgh$  (b)  $\frac{1}{4} mv^2$  (c)  $d/t$  (d)  $\frac{1}{2} mv^2$

- 5 An object its mass is 5 kg is moving at a speed of 10 m/s, if its mass decreases to half, while its speed remains constant, its kinetic energy becomes.....

- (a) 250 J (b) 150 J (c) 125 J (d) 100 J

- 6 Joule is the measuring unit of kinetic energy, and it is equivalent to.....

- (a)  $g/cm^3$  (b) N (c)  $kg \times (m/s)^2$  (d)  $kg /s^2$

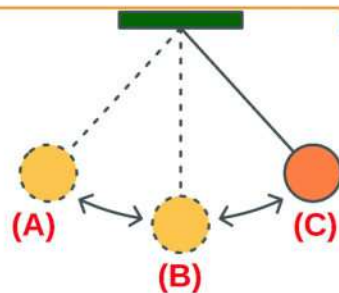
- 7 If the speed of an object decreases to half while its mass remains constant, its kinetic energy.....

- (a) decreases to half. (b) decreases to quarter.  
(c) increases to four times its original value. (d) is doubled.

8 in the figure:

(1) The work done on the ball at point (A) is stored in form of .....

- a** potential energy.      **B** kinetic energy.  
**C** thermal energy.      **D** chemical energy.



(2) When a pendulum ball passes through point (B), the work done at it equals .....

- a** thermal energy.      **B** chemical energy.  
**C** kinetic energy.      **D** potential energy.

9 At the maximum height reached by an object thrown upwards, .....

- a** potential energy is zero.      **B** kinetic energy is zero.  
**C** mechanical energy is zero.      **D** the mass of the object is zero.

10 When an object falls vertically from a height, its mechanical energy at any point before reaching the ground is expressed as

- a** kinetic energy only.      **B** potential energy only.  
**C** kinetic energy - potential energy.      **D** potential energy + kinetic energy.

11 Each of the following has a value of zero, except .....

- a** kinetic energy of an object at the point of its falling.  
**B** potential energy of an object at the moment it reaches the ground surface.  
**C** speed of an object at its maximum height.  
**D** mechanical energy of an object at the moment it reaches the ground surface.

12 From the opposite figure : The mechanical energy of the ball is.....

- a** at its minimum at position (1).  
**B** at its maximum at position (2).  
**C** at its minimum at position (3).  
**D** constant at any position.



2 Complete the following statements :

- 1 The fruit located on the branch of the tree stores..... energy, which transforms into..... energy upon falling.
- 2 The kinetic energy of an object increases with increasing either .....or.....
- 3 The mass of an object is measured in..... , while its speed is measured in.....
- 4 At the maximum height of an object, its mechanical energy is equal to.....energy only , while it is equal to.....energy only, at the moment it reaches the ground surface.
- 5 When a ball falls vertically downwards, the potential energy ..... and the kinetic energy .....
- 6 At the midpoint of the vertical distance between the point of falling of an object and the ground surface, the ..... energy of the object is equal to ..... energy.

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 The unit of measurement for kinetic energy is Newton. ☐
- 2 The kinetic energy of an object increases with an increase in its mass and a decrease in its speed. ☐
- 3 The kinetic energy of an object at rest equals zero. ☐
- 4 The kinetic energy of an object is doubled when its speed is doubled. ☐
- 5 During the vertical throwing of an object, its potential energy increases while its kinetic energy decreases. ☐
- 6 The speed of a pendulum ball is zero when it passes through the original position. ☐
- 7 The potential energy of an object that is at its maximum height equals its kinetic energy at the moment it reaches the ground surface. ☐
- 8 The potential energy of the water held behind the High Dam is converted into electrical energy when it flows downwards. ☐

**4 What is meant by:**

- (1) The kinetic energy of an object equals 100 J
- (2) The kinetic energy of an object its mass is 10 kg equals zero.
- (3) The mechanical energy of a moving object equals 500 J

**5 State the mathematical relation which relates between:**

- (1) The kinetic energy of an object and its mass.
- (2) The kinetic energy of an object and its speed.
- (3) The mechanical energy of an object and its potential and kinetic energies.

**6 Variant problems :**

1. Calculate the mass of an object moving at a speed of 10 m/s if its kinetic energy is 1000 J
2. Calculate the speed of an object with a mass of 20 kg and a kinetic energy of 250 J
3. An object with a mass of 8 kg is moving at a speed of 5 m/s, Calculate:
  - (1) The kinetic energy of the object.
  - (2) The kinetic energy of the object when its speed is doubled, and What can you conclude from that?
4. Calculate the mass of a ping pong ball moving at a speed of 30 m/s, given that its kinetic energy equals the kinetic energy of a bowling ball with a mass of 7.5 kg moving at a speed of 6 m/s
5. Calculate the mechanical energy of a moving object if its kinetic energy is 40 J and its potential energy is 30 J
6. Calculate the kinetic energy of an object if its mechanical energy is 50 J and its potential energy is 30 J
7. A moving pendulum has a mechanical energy of 20 J, Calculate its potential energy and kinetic energy at the highest point it reaches away from its original position.
8. If you know that the potential energy of an object at its maximum height is 400 J , Calculate:
  - (1) The mechanical energy of the object.
  - (2) The potential energy of the object at the midpoint of the vertical distance between the maximum height and the ground surface.
  - (3) The kinetic energy of the object at the moment it reaches the ground surface

**7 Write the scientific term:**

1. It is the acquired energy by an object as a result of its motion. (.....)
2. It is the summation of potential energy and kinetic energy. (.....)
3. It is the ball used for demolishing old buildings. (Greer (.....))

**8 Give reasons for each of the following:**

1. The kinetic energy of a truck is greater than the kinetic energy of a car when their speeds are equal.
2. The work required to move a car increases as its mass increases.
3. The kinetic energy of an object increases during its falling even though its mass is constant.
4. When a pendulum ball passes through the original position, its kinetic energy is at its maximum.
5. The mechanical energy of an object falling from a height is constant despite the decrease in its potential energy.
6. A demolition ball is an example of energy conversions.

**9 What happens in the following cases :**

1. The mass of a moving object decreases to half while its speed remains constant "Regarding kinetic energy".
2. The speed of a moving object is doubled while its mass remains constant "Regarding kinetic energy".
3. The pendulum ball is drawn upwards from its original position, then released "Regarding the speed of the ball".
4. The pendulum ball passes through the original position during its motion "Regarding its kinetic and potential energies."



# UNIT( 3 )

---

Environment and  
Genetics

## The Ecosystem

The ecosystem consists of both **living organisms** and **non-living components**, working together in a specific environment.

### A. Components of the Ecosystem

#### ✓ Living (Biotic) Organisms

- **Plants**
- **Animals**
- **Birds**
- **Microorganisms**



#### ✓ Non-Living (Abiotic) Components

- **Water**
- **Air**
- **Soil**
- **Sunlight**
- **Temperature & Climate**



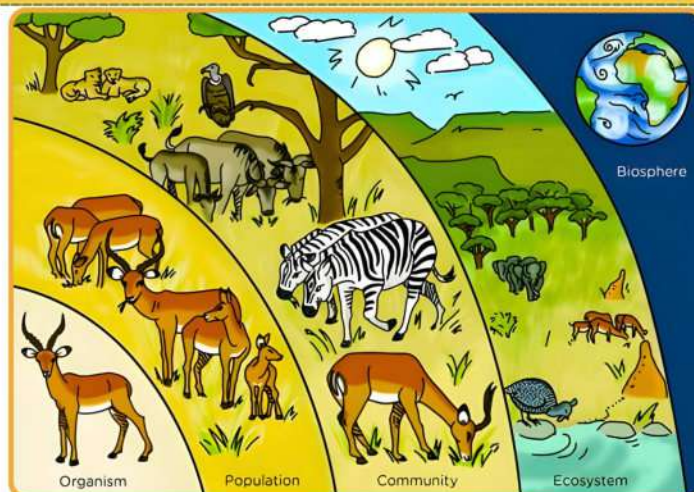
### Levels of Organization in the Ecosystem

- starting from the individual that belongs to a specific species of living organisms,

Level	Definition	Example
<b>Individual</b>	A single living organism	A lion 🦁
<b>Biotic Population</b>	A group of individuals of the same species living in a specific area	A herd of zebras 🦓 / A group of lions
<b>Biological Community</b>	Different populations living together in the same environment	Lions, zebras, trees 🌳
<b>Ecosystem</b>	The interaction between living organisms and non-living components	A forest 🌲

### Species

is the fundamental unit (the basic unit ) of classifying living organisms.



## Patterns of Nutritional Relationships in Biological Communities

Living organisms interact with each other in different ways to obtain food. These relationships include:

1 Predation (Hunting) 🦁🐘

2 Competition ✂️

3 Mutualism 🤝

4 Commensalism 🦎



### 1 Predation (Hunting) 🦁🐘

• A relationship where one organism (**predator**) hunts, kills, and eats another organism (**prey**).

✓ **Predator (Beneficiary):** The organism that hunts.

✓ **Prey (Harmed):** The organism that gets eaten.

#### Examples of Predation:

A lion hunting a zebra.



A chameleon catching an insect.



A Dionea (Venus flytrap) eating an insect.



### 2 Competition ✂️

• A relationship where two individuals of the same species compete for limited food resources, which negatively affects both of them (affecting their survival and growth)

#### Example of Competition:

Two lions fighting over a zebra. 🦁🦁



**NOTES** \* If food resources decrease, competition increases, leading to a decrease in population numbers.

### 3 Mutualism (Win-Win Relationship)

- A relationship where both organisms benefit without harming each other.

#### Example of Mutualism:

Bees and flowers :

- ✓ Bees get nectar from flowers 🍯.
- ✓ Flowers get pollinated by bees 🐝.



### 4 Commensalism

- A relationship where one organism benefits (commensal), while the other (host) is neither harmed nor benefited.

#### Example of Commensalism:

Egyptian plover  
bird and the Nile  
crocodile 🐊

- ✓ The bird benefits by eating leftover food stuck in the crocodile's teeth.
- ✓ The crocodile is neither harmed nor benefited.



#### للإطلاع فقط

التمساح يستفيد أيضًا من هذه العملية. حيث يقوم طائر الرقراق المصري (Egyptian Plover) بإزالة بقايا الطعام من أسنان التمساح، مما يساعد على تنظيف فمه وتقليل خطر العدوى أو التلوث. لذلك، هذه العلاقة أقرب إلى التكافل (Mutualism) وليس التعايش (Commensalism)، لأن كلا الطرفين يستفيد.

#### NOTES

- The crocodile does not benefit

→ because it can live without cleaning its teeth.



الأحلام تتحقق لمن يؤمن بها ويعمل لأجلها

## Classification of Living Organisms Based on Nutrition

Living organisms are classified into:

Category	Definition	Examples
Producers	Autotrophic organisms that make their own food through photosynthesis	Plants, Algae
Consumers	Heterotrophic organisms that depend on others for food	Animals
Decomposers	Organisms that break down dead bodies into simpler substances	Bacteria, Fungi

### Consumers

(Types of Animals Based on Diet)

Consumers are divided into:

Type	Diet	Examples
Herbivores (Plant-eaters)	Feed on plants only 🌿	Horse, Rabbit 🐇
Carnivores (Meat-eaters)	Feed on meat only 🥩	Lion, Snake 🐍
Omnivores (Both Plants & Meat)	Feed on plants and animals	Bear, Raven, Mouse, Hedgehog
Scavengers (Dead Organism Feeders)	Feed on dead organisms	Hyenas, Eagles, Cockroaches 🪳

### NOTES

Why are decomposers called by this name?

- Because they break down the organic substances in dead organisms into simpler substances, which mix with the soil and become part of its components.

Why are decomposers important?

- Because they break down dead organisms, returning nutrients to the soil 🌱

## Energy Flow Among Living Organisms

- All living organisms need energy to survive.
- The **Sun** is the **main source of energy** for all life on Earth.

◆ Energy is transferred through:

1 Food Chains

2 Food Webs

3 Energy Pyramids

### 1 Food Chains

The path by which energy moves from **one** organism to another.

◆ Example of a Food Chain:

terrestrial

aquatic

desert

terrestrial

**Producer :** Grasses

///

**Primary consumer :** Rabbit

///

**Secondary consumer :** FOX

**Tertiary consumer :** Eagle

///

**Decomposer :** Bacteria - Fungi



**Take care:**

In some food chains, certain animals can be **both predators and prey** at the same time.

Example:

In the previous food chain, the Fox preys on the rabbit, while it is preyed on by the eagle.

### aquatic

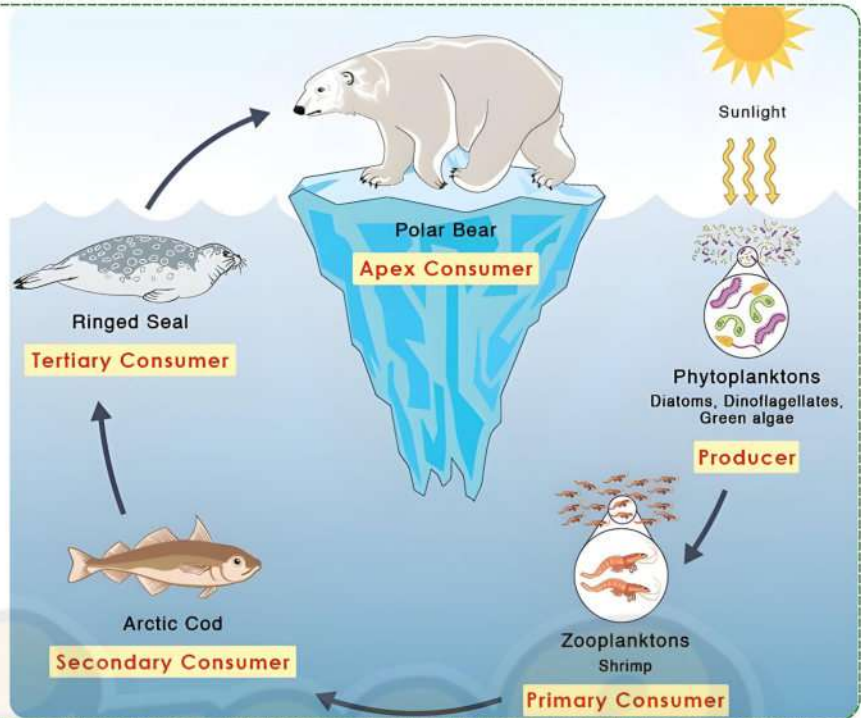
**Producer : Algae** (phytoplanktons)

**Primary consumer :** Zooplanktons

**Secondary consumer :** Arctic cod

**Tertiary consumer :** Ringed seal

**Quaternary (Apex) consumer :** Polar Bear



## 2 FoodWebs

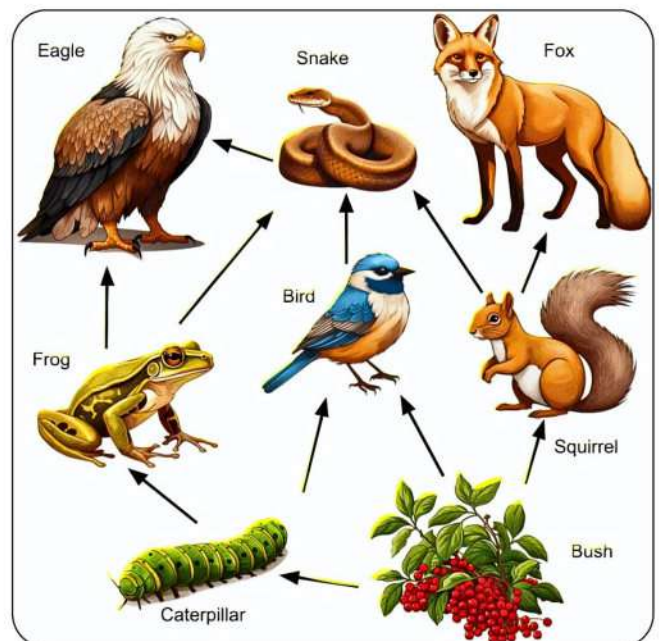
- A network of interconnected food chains showing the complex feeding relationships in an ecosystem.
- The interconnect and overlapping of multiple food hails together.

### Why do food webs exist?

Because most organisms eat more than one type of food and are eaten by multiple predators.

### Example: A bird can be:

- ✓ A primary consumer (if it eats plants 🌱).
- ✓ A secondary consumer (if it eats insects (Caterpillar)).
- ✓ A prey (if a Snake eats it).



### 3 Energy Pyramids

- A pyramid that shows how energy flows between trophic levels in a food chain.

- ✓ Only **10%** of energy from one level is **transferred** to the next.
- ✓ **90%** of energy is **lost** as heat or used for life functions.

Trophic Level	Example	Energy Transfer
Producers	Green plants 🌱	100% energy
Primary Consumers	Herbivores (Cow 🐮)	10% energy
Secondary Consumers	Carnivores (Fox 🦊)	1% energy
Tertiary Consumers	Top predators (Eagle 🦅)	0.1% energy

✓ **Example:** A cow loses 90% of the energy from the grass it eats, passing only 10% to the carnivore that eats it.

### " 10% Rule "

- Only **10% of the energy is transferred** from one trophic level to the next, while **90% is lost as heat or used for life processes**.

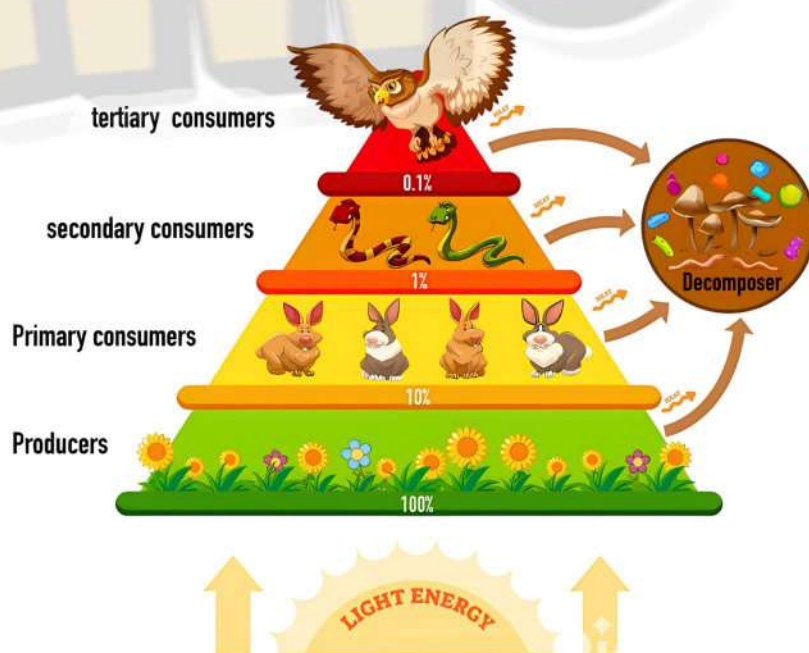
#### Problem :

In a food chain, if the energy of the producer is 1000 energy units, then the energy of the secondary consumer equals ..... energy units.

#### Solution Steps:

- Energy of the producer: 1000 energy units.
- Energy of the primary consumer :  $1000 \times 10\% = 100$  energy units
- Energy of the **secondary consumer** :  $100 \times 10\% = 10$  energy units

✓ Answer: 10 (energy units)



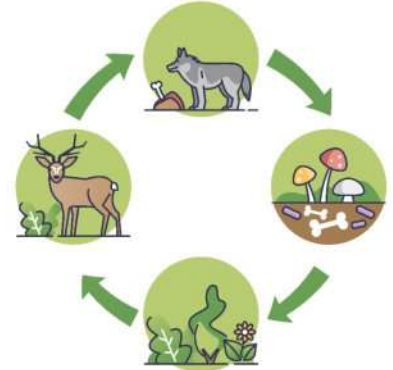
## Ecological Balance

➔ The removal of one species affects the whole food chain.

✓ Example:

- ✓ If birds migrate, the number of locusts increases (since there are fewer predators).
- ✓ This leads to more locusts eating plants, reducing plant life.
- ✓ Fox populations decrease due to fewer birds to eat.

⚠ Lack of food increases competition among organisms, affecting population sizes



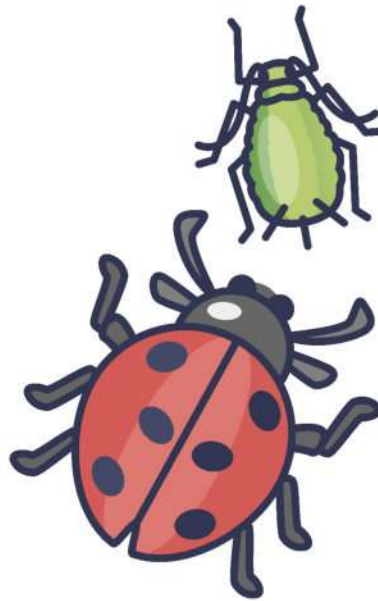
## Life Application: Sustainable Agriculture

### Biological Control:

- A method of using living organisms instead of pesticides to control pests.

✓ Example:

Ladybugs 🐞 are used to eat aphids, which damage crops.



المستقبل يصنعه من يجتهد الآن، فكن أنت صانع مستقبلك

## words of the lesson

The ecosystem	النظام البيئي	Leftover food	بقايا الطعام
Living organisms	الكائنات الحية	Producers	المنتجون
Abiotic components	المكونات غير الحية	Autotrophic organisms	الكائنات ذاتية التغذية
Individuals	الأفراد	Consumers	المستهلكون
Species	الأنواع	Heterotrophic organisms	الكائنات غير ذاتية التغذية
Biological communities	المجتمعات الحيوية	Herbivores	آكلات الأعشاب
Biotic populations	الجماعات الحيوية	Carnivores	آكلات اللحوم
Nutritional relationships	العلاقات الغذائية	Omnivores	الكائنات القارئة (آكلات اللحوم والنباتات)
Patterns	الأنماط	Scavengers	القمامون
Predation	الافتراس	Raven	الغراب
The predator	المفترس	Cockroaches	الصراصير
The prey	الفريسة	Decomposers	المحللات
Panther chameleon	حرباء النمر	Decompose	التحلل
Competition	التنافس	Trophic level	المستوى الغذائي
Food resources	الموارد الغذائية	Locust	الجراد
Mutualism	التكافل	Terrestrial chains	السلاسل الأرضية
Benefit	المنفعة	Aquatic chains	السلاسل المائية
Harmed	المتضرر	Desert chains	السلاسل الصحراوية
Commensalism	التعايش	Polar bear	الدب القطبي
Commensal	الكائن المتعايش	Crustaceans	القشريات
Host	العائل (المضيف)	Sustainable agriculture	الزراعة المستدامة
Disruption	خلل	Aphid insect	حشرة المن
Destruction	تدمير	Pesticides	المبيدات الحشرية
Reptiles	زواحف	Ecological balance	التوازن البيئي

Questions



EL-MOASSER

1 Choose the correct answer:

1 Which of the following nutritional relationships causes harm to one of the organisms ?

- ☐ a Predation and competition ☐ b Mutualism and commensalism.  
☐ c Mutualism and predation ☐ d Predation and commensalism.

2 The nutritional relationship which results In harm to both individuals is.....

- ☐ a predation ☐ b mutualism ☐ c commensalism ☐ d competition

3 Each of the following food relationships represents predation, except the relationship between..... and .....

- ☐ a Lion and Zebra ☐ b Dionaeea plant and insect.  
☐ c Nile crocodile and plover bird. ☐ d wolf and wild rabbit.

4 Predators of the same species which live in the same ecosystem.....

- ☐ a become decomposers. ☐ b compete for food.  
☐ c make their own food. ☐ d obtain their energy from the sun.

5 Herbivores are .....

- ☐ a producers. ☐ b scavengers. ☐ c consumers. ☐ d decomposers

6 Among the living organisms that obtain their food from plants and animals are .....

- ☐ a eagles and hyenas. ☐ b snake and cow. ☐ c rabbit and mouse. ☐ d hedgehog and bear.

7 The animal (X) feeds on small animals and the roots of plants, thus it is classified as a (an).....

- ☐ a omnivore. ☐ b scavenger ☐ c rodent ☐ d decomposer

8 Among the organisms that feed on the bodies of dead organisms are.....

- ☐ a hyenas. ☐ b fungi ☐ c cockroaches ☐ d foxes

9 The main source of energy on the surface of the Earth is.....

- ☐ a the consumers. ☐ b the producers. ☐ c the plants. ☐ d the Sun.

10 Decomposers in food chains.....

- a make their food through photosynthesis.
- B recycle the nutrients to the ecosystem.
- C absorb energy from the sun.
- D produce new food substances.

11 Which of the following indicates the correct path of energy in a food chain ?

- a Grass → Cow → Human → Sun.
- B Sun → Grass → Cow → Human.
- C Human → Cow → Grass → Sun,
- D Cow → Grass → Sun → Human.

12 Which of the following obtain energy from the other three types ?

- a Producers.
- B Decomposers
- C Carnivores
- D Herbivores.

8 The base of the energy pyramid is occupied by .....

- a producers.
- B primary consumers.
- C tertiary consumers.
- D the decomposers.

13 The amount of energy lost when moving from any trophic level to the next level in the energy pyramid equals.....

- a 1%
- B 10%
- C 90%
- D 100%

14 In a food chain, if the energy of the producer is 1000 energy units, then the energy of the secondary consumer equals ..... energy units.

- a 1000
- B 100
- C 10
- D 0.1

## 2 Complete the following statements :

1 Any ecosystem consists of ..... each of them composed of biotic populations which consist of .....

2 The opposite figure shows a ..... relationship between which is cat and ..... which is mouse.

3 The nutritional relationship between bees and plant flowers is .....while the nutritional relationship between Dionaea plant and insect is.....

- 4 The plant benefits from bee by transferring ..... from one flower to another to promote the process of.....
- 5 The individual that neither benefits nor is harmed from this relationship is .....and is referred to as.....
- 6 Producers are called.....organisms, while consumers are called.....organisms .
- 7 Most herbivorous animals are characterized by the presence of.....for cutting plants,While most carnivorous animals are characterized by the presence of..... for tearing prey.
- 8 Fungi are considered from ....., while .....from herbivores.
- 9 The food chain begins with ..... such as ..... and ends with ..... such as bacteria,
- 10 Producers obtain energy from ..... , While the ..... obtain their energy from producers.

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 The biological community consists of living organisms and abiotic componens found in a certain place. ☐
- 2 The nutritional relationship between lion and tiger is a predation. ☐
- 3 The bees benefit only from the nutritional relationship between bees and plant flowers. ☐
- 4 Only the host benefits in the commensalism. ☐
- 5 The animal is the only living organism that makes its own food. ☐
- 6 Fungi and bacteria break down organic substances in the dead bodies into simpler substances that mix with the soil. ☐
- 7 The primary consumer is always a herbivore. ☐
- 8 The food chain consists of several overlapped food webs. ☐
- 9 Energy flows from the consumers to the producers in the food web. ☐
- 10 The number of rabbits in a biological community increases when predators decrease. ☐
- 11 90% of energy is transferred in the energy pyramid from one trophic level to the next one ☐

**4 Write the scientific term for each of the following statements :**

- (1) Any place that includes living organisms and non-living (abiotic) components and includes several levels of organization.
- (2) The fundamental unit in the classification of the living organisms.
- (3) The various biotic populations of different species that inhabit the same environment
- (4) A group of individuals of the same species living in a particular place at the same time.
- (5) A nutritional relationship between two individuals where one of them benefits, while the other individual is harmed or loses its life.
- (6) A nutritional relationship between two individuals of the same species for a source that exists in limited quantities.
- (7) A nutritional relationship between two individuals where both of them benefit from each other without causing harm to either of them.
- (8) A nutritional relationship between two individuals known as the commensal and the host.
- (9) A nutritional relationship between two individuals, one Of them benefits and the other neither benefits nor is harmed.
- (10) Autotrophic organisms that can make their own food through the photosynthesis process.
- (11) Animals that depend on the producers to obtain their food.
- (12) Consumers that feed on plants and animals.
- (13) Consumers that feed on the remains of dead organisms.
- (14) Organisms that obtain energy from the breaking down of the organic substances found in dead bodies.
- (15) Each stage in which energy is transferred in tho food chain
- (16) A method in which utilisation of living organisms through food systems to eliminate agricultural pests instead of using pesticides
- (17) The interconnection and overlapping of multiple food chains together
- (18) A pyramid represents the flow of energy and its amounts between different trophic levels in any food chain.

**5 Give one example for each of the following:**

- |                   |                  |                          |
|-------------------|------------------|--------------------------|
| (1) Predation.    | (2) Competition. | (3) Mutualism.           |
| (4) Commensalism. | (5) Producer.    | (6) Consumer.            |
| (7) Herbivore.    | (8) Carnivore.   | (9) Omnivore.            |
| (10) Scavenger.   | (11) Decomposer. | (12) Biological control. |

**6 Mention the importance of each of the following:**

- |                                   |                                 |
|-----------------------------------|---------------------------------|
| (1) Decomposers in the ecosystem. | (2) The sun in the ecosystem.   |
| (3) Producers in the food chain.  | (4) Bees in plant reproduction. |

**7 Mention one difference between each of the following:**

- (1) Biotic population and biological community,
- (2) Predator and prey.
- (3) Plant, animal and bacteria.
- (4) Commensal and host.
- (5) Carnivorous organisms and herbivorous organisms,
- (6) The teeth of both horse and lion,
- (7) Decomposers and scavengers

**8 Correct the underlined words:**

- (1) The individual harmed in the predation is called the host.
- (2) Both individuals are harmed by the commensalism.
- (3) The commensal does not benefit nor is harmed in the commensalism.
- (4) Weeds and grasses make their own food through the process of respiration.
- (5) Omnivores feed on the remains of dead organisms.
- (6) Predators breaking down the wastes and the dead bodies into simpler substances that mix with the soil.
- (7) In the absence of consumers, the dead bodies, accumulate in the environment.
- (8) Oxygen flows among living organisms in food chains.

## Genetic Traits and Acquired Traits



### Types of Traits in Living Organisms

All living organisms have a set of **traits and behaviors** that can be classified into two main types:

#### A. Genetic Traits

- Traits **passed from parents** to offspring through genes.
- They are not learned and are **inherited** from one generation to the next.

##### ✓ Examples:

1. Human hair color 🧑
2. Eye color 👁️
3. Short legs of the Arctic fox 🦊
4. The long neck of a giraffe 🦒
5. The hard skeleton covering a turtle's body 🐢



#### B. Acquired Traits

- They **do not pass** from one generation to another.
- Traits that are **not inherited** but learned or developed through experience or training.

##### ✓ Examples:

1. A child learning to walk 🧒
2. A sports champion building muscles 💪
3. A dolphin playing with a ball 🐬🏈
4. Learning new languages 🗣️
5. A horse jumping over obstacles 🐎



#### C. Instinctive Behaviors (Instincts)

- Inherited behaviors that do not require learning.
- These behaviors are programmed into an organism's DNA.

##### ✓ Examples:

1. A bat sleeping upside down 🦇
2. A chicken laying eggs 🐔🥚
3. A squirrel breaking a hazelnut shell 🐿️
4. A spider weaving its web 🕸️
5. A bird building its nest 🐦



## Chromosomes and the Transmission of Genetic Traits

### Reproduction:

A process where living organisms produce offspring that inherit their traits.

### Chromosomes:

- Thread-like structures in the nucleus of eukaryotic cells that carry genetic material (DNA).
- **Responsible for** passing traits from parents to offspring.

### ✓ Location of Chromosomes:

- **Eukaryotic cells** → Found in the **nucleus**.
- **Prokaryotic cells** → Found in the **cytoplasm**.

### ✓ Number of Chromosomes in Different Organisms:

Living Organism	Number of Chromosomes
Humans 🧑	46
Bees 🐝	32
Corn Plant 🌽	20



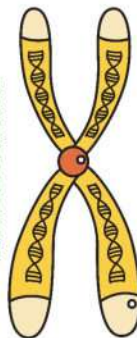
### NOTES

- Each individual inherits **half of its chromosomes** from the father and the **other half** from the mother.
- Individuals of the **same species** have the **same number of chromosomes** in each of their **somatic cells**, such as **liver and skin cells**.

### ✓ Structure of Chromosomes

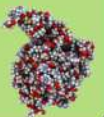
#### A. General Composition:

- Each chromosome consists of **two chromatids**, connected by a **centromere**.



#### B. Chemical Composition:

- Made of **DNA (Deoxyribonucleic Acid)** wrapped around histone proteins.



### Centromere

The central point at which the two chromatids of the chromosome are connected,

## Chemical Structure of DNA (nucleic acid)

### DNA (Deoxyribonucleic Acid):

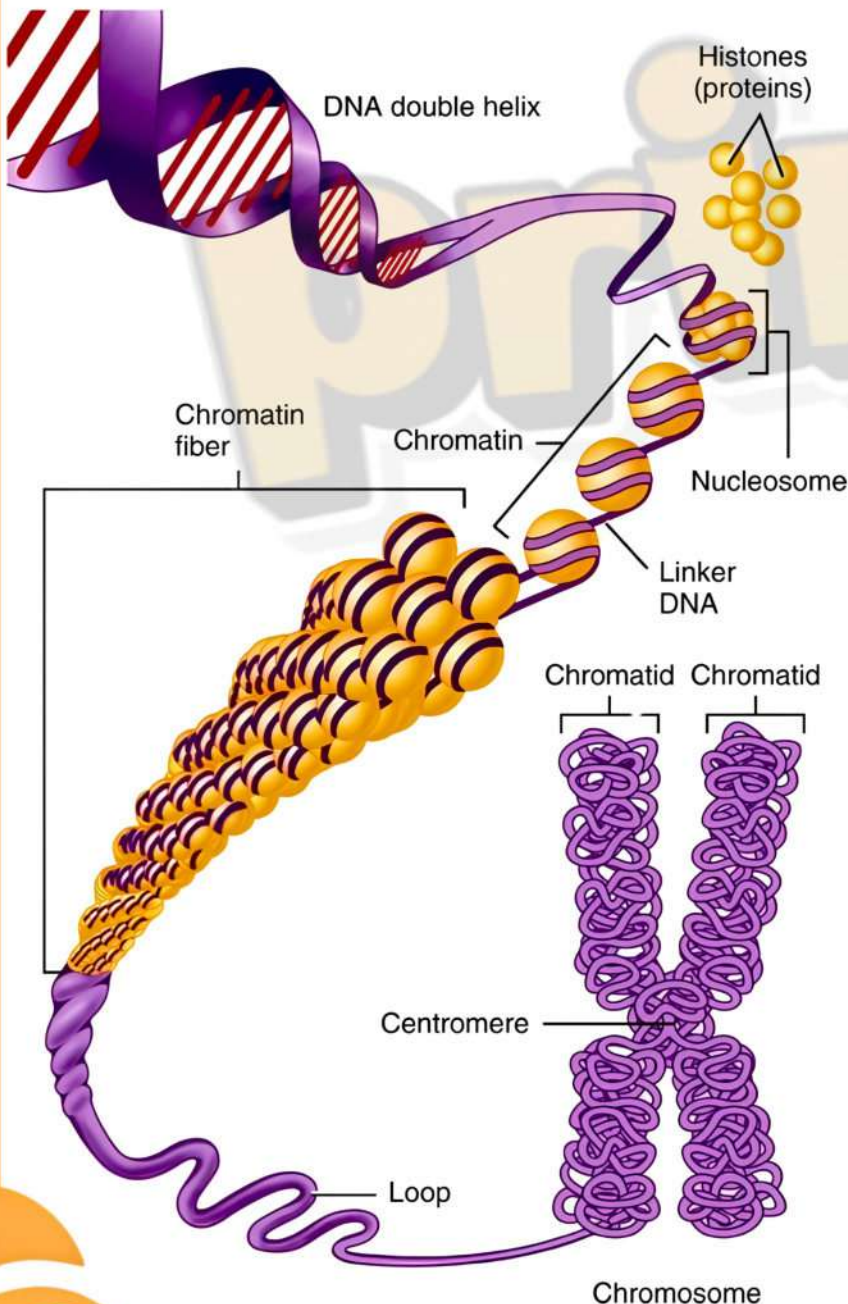
- A molecule made of **small segments called genes.**
- **Responsible for hereditary traits in living organisms.**
- **DNA is structured as a double helix.**

### Genes:

- Segments of DNA that determine specific traits.
- Each gene consists of a sequence of smaller building units **called nucleotides.**

### nucleotides

- The smallest building unit of the nucleic acid DNA



## Genetic Material Organization:

Cell in eukaryotes



Contains a nucleus



Contains chromosomes



Made of DNA



Divided into genes



Built from nucleotides.

## The Role of Genes in Hereditary Traits

- ✓ **Genes** : control traits and are passed from parents to offspring.
- ✓ The science that studies genetic inheritance **is called genetics**.



### Gregor Mendel ( the father of genetics )

- Conducted experiments on pea plants for 8 years (studied 24,000 plants).
- Discovered that each hereditary trait is controlled by a pair of genetic factors (later called genes).
- His research laid the foundation for **modern genetic engineering**.

### One Gene – One Enzyme Hypothesis (Beadle & Tatum):

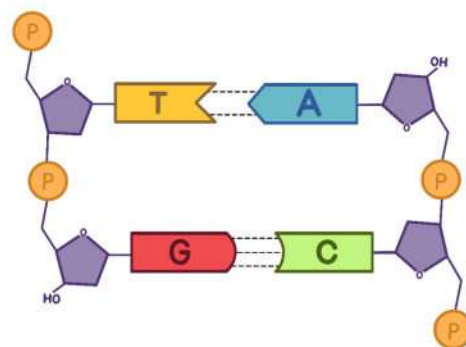
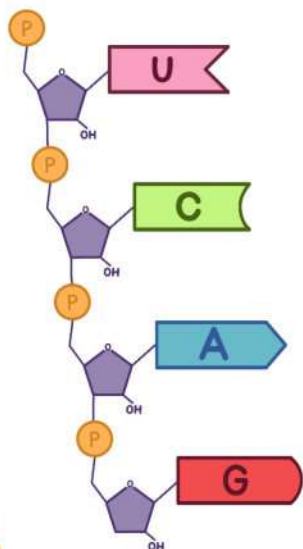
- Each **gene** produces a **specific enzyme**, responsible for a chemical reaction that creates a **protein**, which expresses **a specific hereditary trait**

### ◆ Example: The Inheritance of Curly Hair

1. A child inherits the gene for curly hair from a parent.
2. This gene produces an enzyme that triggers a chemical reaction, forming a protein responsible for curly hair.

### NOTES ✨ Why do people have different traits?

- The arrangement of nucleotides in DNA varies, leading to different genes responsible for different traits.



## Mutations (Genetic Changes)

is a change in a gene that results in a new trait that did not previously exist.

### Examples of Mutations:

- The appearance of giant cows. 🐄
- A person born with six fingers on one hand. 🖐️



### Types of Mutations

#### A. Based on Origin

Type	Definition	Example
Spontaneous Mutations الطفرات التلقائية	Happen naturally <b>without</b> human intervention.	Albino mutation (albinism).
Induced Mutations الطفرات المستحثة	Caused <b>by</b> human intervention.	Featherless chickens (to reduce farm cooling costs).



#### B. Based on Impact

Type	Definition	Example
Harmful Mutations ✗	Cause <b>undesirable</b> traits and may be lethal.	Spinal deformities, muscular dystrophy in newborns.
Beneficial Mutations ✓	Cause <b>desirable</b> traits, either naturally or through human intervention.	Lighter skin in cold countries for better Vitamin D absorption.



### Examples of Induced Beneficial Mutations:

- Seedless fruits 🍈
- Wheat plants resistant to disease 🌾



## Integration with Agricultural Science

### ◆ Cubic-Shaped Watermelons 🍉:

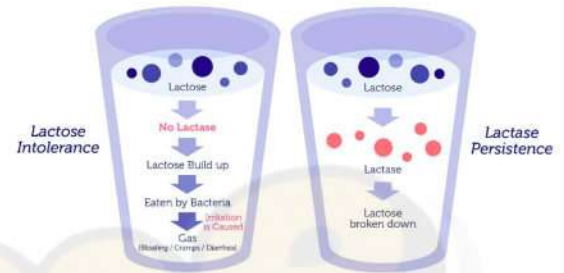
- NOT a mutation but a farming technique.
- Watermelons grow in square molds, taking their shape for easier transport.



## Life Applications of Mutations

### Lactose Tolerance Mutation 🥛

- Some people can digest lactose (milk sugar) because of a beneficial spontaneous mutation.
- Lactose-intolerant individuals feel cramps and nausea after consuming dairy products.



### Alternative Dairy Options:

Dairy Products 🥛	Alternatives 🌱
Butter 🧈	Olive oil
Milk 🥛	Soy milk, Almond milk
Coffee creamer 🍵	Non-dairy creamer
Milk chocolate 🍫	Dark chocolate



## words of the lesson

Genetic traits (Hereditary trait)	الصفات الوراثية	Mutations	الطفرات
Acquired traits	الصفات المكتسبة	The origin	الأصل
Instinctive behaviours	السلوكيات الغريزية	The impact	التأثير
Instinct	الغريزة	Spontaneous mutation	الطفرة التلقائية
Offspring	النسل	Induced mutation	الطفرة المستحثة
Inherited	موروث	Intervention	التدخل
Arctic fox	الثعلب القطبي	Albino	المهق (الألبينو)
Generation	جيل	Desirable	مرغوب فيه
Behaviours	السلوكيات	Undesirable	غير مرغوب فيه
Skills	المهارات	Spinal deformity	تشوه العمود الفقري
Chicken laying	وضع البيض لدى الدجاج	Lethal mutations	طفرات مميتة
Hard skeleton	هيكل صلب	Agricultural technique	تقنية زراعية
Obstacles	العوائق	Severe muscular dystrophy	الحثل العضلي الشديد
Facial freckles	نمش الوجه	Lactose intolerance	عدم تحمل اللاكتوز
Breastfeeding	الرضاعة الطبيعية	Feel crampy	الشعور بالتقلصات
Reproduction	التكاثر	Nausea	الغثيان
Thread-like bodies	أجسام خيطية الشكل	Dairy products	منتجات الألبان
Genetic material	المادة الوراثية	Mating	التزاوج
Somatic cells	الخلايا الجسدية		
Nucleic acid	الحمض النووي		
Double helix	اللولب المزدوج		
Founder	المؤسس		
Hypothesis	الفرضية		
Mechanism	آلية عمل		

Questions



EL-MOASSER

1 Choose the correct answer:

1 Which of the following is inherited by a child from their parents ?

- a** Driving a car. **B** Curly hair.  
**C** Strong muscles **D** Proficiency in French.

2 The spider weaving its web is considered.....

- a** a Spontaneous mutation. **B** an acquired trait.  
**C** a genetic trait **D** an instinctive behaviour

3 Which of the following is an acquired trait ?

- a** Facial freckles **B** A dolphin playing with a ball  
**C** A squirrel breaking hazelnut shell **D** A chicken laying on the eggs

4 The number of chromosomes in corn plant cells equals ..... chromosomes.

- a** 20 **B** 26 **C** 32 **D** 46

5 The central point at which the two chromatids of the chromosome are connected is called .....

- a** the nucleotide. **B** the centrosome. **C** the gene. **D** the centromere.

6 Histones are .....

- a** enzymes. **B** proteins. **C** fats. **D** carbohydrates

7 The gene consists of a sequence of.....

- a** chromosomes. **B** chromatids **C** nucleotides **D** proteins

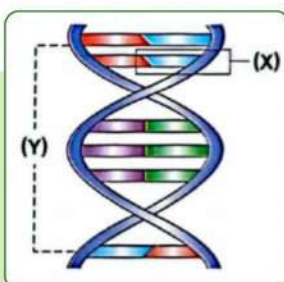
8 From the opposite figure :

1- The part referred to by the letter (X) is a.....

- a** chromatid. **B** chromosome **C** histone **D** nucleotide.

2-Which of the following statements is correct about the part referred to by the letter (Y) ?

- a** The smallest building unit of the nucleic acid DNA  
**B** Responsible for the appearance of a hereditary trait of the living organism.  
**C** A type of protein. **D** Absent in prokaryotes.



9 The genetic material that found in cells and determine hereditary traits of the living Organism is called .....

- a** PNA      **b** NAD      **c** AND      **d** DNA

10 The two scientists who affirmed the hypothesis of one gene - one enzyme through their experiments are .....

- a** Beadle and Crick.      **b** Mendel and Tatum.  
**c** Beadle and Tatum.      **d** Watson and Crick.

11 Genes control the appearance of hereditary traits in the living organism by producing .....

- a** chromosomes.      **b** vitamins      **c** hormones      **d** enzymes.

12 From the induced mutations is .....

- a** production of wheat plants resistant to wheat rust disease.  
**b** learning languages.  
**c** production of cubic-shaped watermelons.  
**d** blue eyes.

13 Millions of nucleotides Come together directly, forming .....

- a** chromosomes      **b** chromatids      **c** genes      **d** histones

## 2 Complete the following statements :

1 The short legs of Arctic fox is a .....trait , while the taming lions is a .....trait

2 DNA is composed of small segments called ....., each of them consists of a sequence of .....

3 The scientists Beadle and Tatum concluded that each gene is responsible for producing..... , which is responsible for the formation of .....

4 ..... traits are transmitted from parents to offspring without learning, while..... traits are not inherited from one generation to the next and are learned from the surrounding environment.

- 5 Human skin colour is a (an) ..... trait, while building strong muscles is a (an)..... trait.
- 6 Among the behaviours and skills that are transmitted from parents to offspring without learning are ..... and .....
- 7 The genetic material is found in..... of the prokaryotes, while it is found in..... of the eukaryotes.
- 8 The number of chromosomes in human skin cell is..... chromosomes, while that in bee cell is ..... chromosomes.
- 9 A chromosome is chemically composed of a nucleic acid called..... twisted around a protein known as.....
- 10 .....is a part of the nucleic acid DNA that consists of a sequence of smaller building units called.....
- 11 The scientist Mendel concluded from his experiments that each hereditary trait is controlled by a pair of .....which were later known as .....
- 12 The scientists..... and .....succeeded in discovering the role of the gene in appearance of hereditary traits.
- 13 Each gene produces a specific..... responsible for the occurrence a..... leads to the formation of a..... that expresses a specific hereditary trait
- 14 An albino child is an example of..... mutation, while the production of seedless fruits is..... mutation.

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 The presence of a hard skeleton covering the turtle's body is an acquired trait. ☐
- 2 instinctive behaviours are transmitted from one generation to the next through learning and training ☐
- 3 individuals of the same species have different number of chromosomes present in their somatic cells. ☐
- 4 Chromosomes are small segments of the nucleic acid DNA ☐
- 5 A single chromosome carries thousands or millions of genes. ☐
- 6 An individual inherits half of his genetic material from the father and the other half from the mother. ☐

- 7 A Change in the arrangement of the nucleotides on DNA leads to a change in the hereditary traits. ☐
- 8 Human control the occurrence of spontaneous mutations. ☐
- 9 Light skin colour in individuals living in cold countries is considered a harmful induced mutation. ☐
- 10 individuals who suffer from lactose intolerance can alternate olive oil by butter, ☐
- 11 A Change in the nature of the gene leads to a change in the hereditary trait which responsible for it and the appearance of a new hereditary trait. ☐

**4 Correct the underlined words:**

- (1) Chromosomes are circular bodies in eukaryotic organisms.
- (2) Genetic material is found in the cytoplasm of the eukaryotes.
- (3) The scientist Tatum is considered the founder of genetics.
- (4) The gene produces a specific protein that is responsible for occurrence of a specific chemical reaction.
- (5) The production of featherless chickens from the lethal mutations.
- (6) The production of cubic-shaped watermelons is an induced mutation.

**5 Give one example for each of the following :**

- |                           |                       |                            |
|---------------------------|-----------------------|----------------------------|
| (1) Genetic trait.        | (2) Acquired trait.   | (3) Instinctive behaviour, |
| (4) Spontaneous mutation. | (5) Induced mutation. | (6) Beneficial mutation,   |
| (7) Harmful mutation.     | (8) Lethal mutation.  |                            |

**6 What are the results of each of the following:**

- (1) The formation of a specific enzyme by a gene.
- (2) Variation in the arrangement of nucleotides on DNA
- (3) Change in the nature of a specific gene.
- (4) Severe muscular dystrophy in some newborn infants.
- (5) Placing the watermelons in a square molds during its growth.
- (6) A person suffering from lactose intolerance eats a piece of milk chocolate.

**4 Choose the odd word (or sentence) out, and mention the relation between the rest:**

1. Human hair colour / Length of the Giraffe's neck / Horse jumping over obstacles / The presence of a hard skeleton Covering the turtle's body.
2. Building strong muscles / Reading and writing / Dolphin playing with a ball / Chicken laying on eggs.
3. The spider weaving its web / facial freckle / Squirrel breaking hazelnut shell / Bat sleeping upside down.
4. Producing seedless lemons / Spinal deformity / Producing cubic-watermelons / Skin colour changing to adapt the environment.

**4 Classify the following into inherited traits, acquired traits and instinctive behaviours :**

- (1) Eye colour.
- (2) Reading and writing.
- (3) Short legs of the Arctic fox.
- (4) Facial freckles.
- (5) The squirrel breaking hazelnut shell.
- (6) The presence of a hard skeleton covering the turtle's body.
- (7) The bird buildi its nest.



# UNIT( 4 )

Natural Cycles

## The Water

### introduction

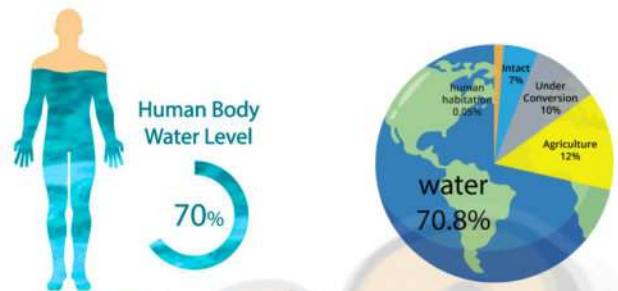
- Water is one of the most important natural resources on Earth.
- It is essential for all living organisms and plays a crucial role in **maintaining environmental balance**.
- The total amount of water on Earth remains constant , but it continuously moves through different states and locations in a process called the water cycle.

### Importance of Water

#### Water makes up:

- 70% of the human body
- 71% of Earth's surface

#### Types of Water on Earth:



Type of Water	Percentage
Saltwater (Oceans & Seas)	97%
Freshwater (Lakes, Rivers, Groundwater, Ice Caps)	3%

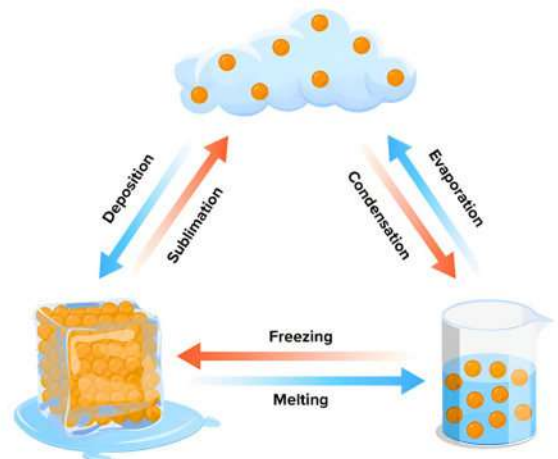
### NOTES

- Freshwater is limited! Since only 3% of Earth's water is freshwater, we must use it wisely to ensure sustainability for future generations.

#### Uses of Water:

- ✓ Drinking 🥤
- ✓ Agriculture (Irrigation) 🌾
- ✓ Sanitation & Hygiene 🚰
- ✓ Regulating Earth's Temperature 🌡️

### States of Water



State	Example	Process of Change
Solid	Ice	Melting (Solid → Liquid)
Liquid	Water	Evaporation (Liquid → Gas)
Gas	Water Vapor	Condensation (Gas → Liquid)

## NOTES

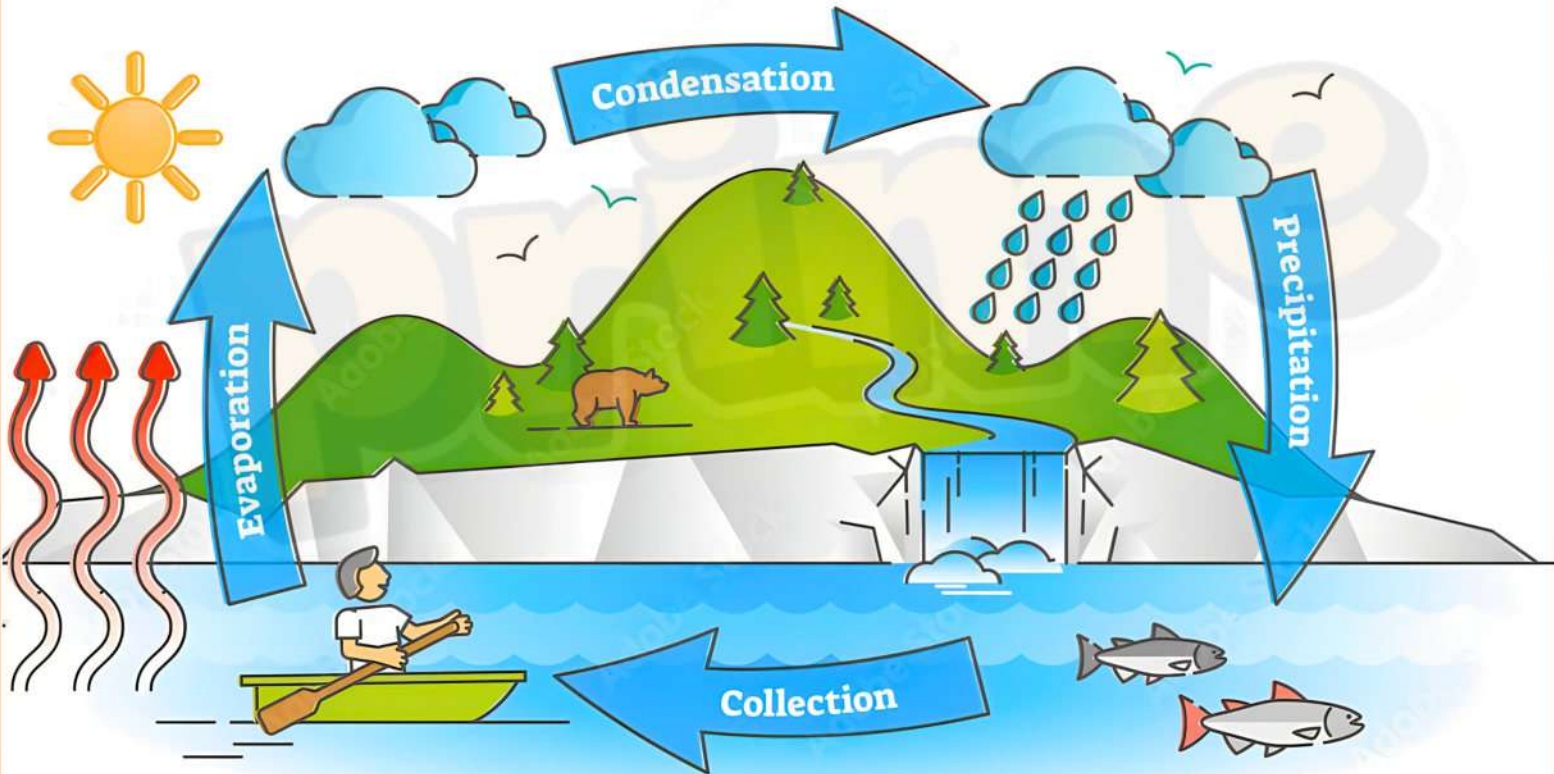
- Water can change states by **gaining or losing heat**.
- Evaporation and Condensation are **opposite processes**.

## The Water Cycle

### Water Cycle

A natural process where water moves between Earth's surface and the atmosphere in a closed multi-path cycle.

## WATER CYCLE



## NOTES

- Water can change states by **gaining or losing heat**.
- Evaporation and Condensation are **opposite processes**.

### A Evaporation (Liquid → Gas) ☀️💨

◆ The process of converting water from liquid to gas when it gains heat.

#### ✓ Example:

- Water in an open cup evaporates under sunlight .

( Evaporation occurs at any temperature **but is faster in hot regions.** )

🔥 Why is evaporation faster in tropical regions?

- Sunlight in tropical regions **is stronger and direct**, while in polar regions, sunlight **is weaker and spread out**.

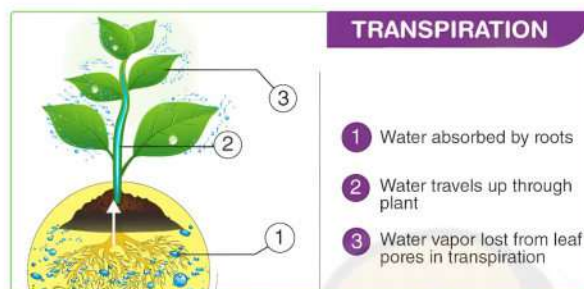
#### ✓ Difference between Evaporation & Boiling:

**Evaporation** : happens at any temperature.

**Boiling** : happens at a specific temperature (boiling point).

#### ✓ Other sources of water vapor:

1. Transpiration from plants
2. Evaporation from human and animal sweat



### B Condensation (Gas → Liquid) 💧💨

◆ The process of converting water vapor into liquid when it loses heat.

#### ✓ Example:

- Water droplets forming on a cold glass.    - Cloud formation in the sky .

### C Precipitation (Clouds → Rain / Snow / Hail) ☁️💧❄️

◆ The process where water falls from clouds to Earth's surface due to gravity.

#### ✓ Forms of Precipitation:

- ✓ Rain ☁️💧 (Above freezing temperature).
- ✓ Snow ❄️ (Below freezing temperature).
- ✓ Hail ⚡️❄️ (Ice balls formed during thunderstorms).

🔥 Precipitation replenishes water in rivers, lakes, and groundwater.

### D Surface Runoff & Infiltration

◆ The movement of water due to gravity into lakes, seas, and oceans.

#### ✓ Two Outcomes:

#### (1) Surface Runoff:

- Rainwater flows across the Earth's surface **into rivers, lakes, and oceans**.
- This process returns water back to **large water bodies**.

#### (2) Infiltration:

- Some rainwater soaks into the soil, **becoming groundwater**.
- Groundwater is stored underground and can be **used by plants and wells**.

🔥 Surface Runoff and Infiltration **keep Earth's water balanced**.

## ◆ Factors Maintaining the Water Cycle

- ✓ **1. Sun's Heat** → Causes **evaporation** (water moves from Earth to the atmosphere).
- ✓ **2. Earth's Gravity** → Causes **precipitation** (water returns to Earth).
- ✳ This cycle preserves Earth's water balance and ecosystem stability.

## Life Applications of the Water Cycle

### Desalination of Seawater

A process that removes salt from seawater, making it drinkable and usable for irrigation.

#### ✓ How It Works:

- Uses evaporation and condensation to separate pure water from saltwater.

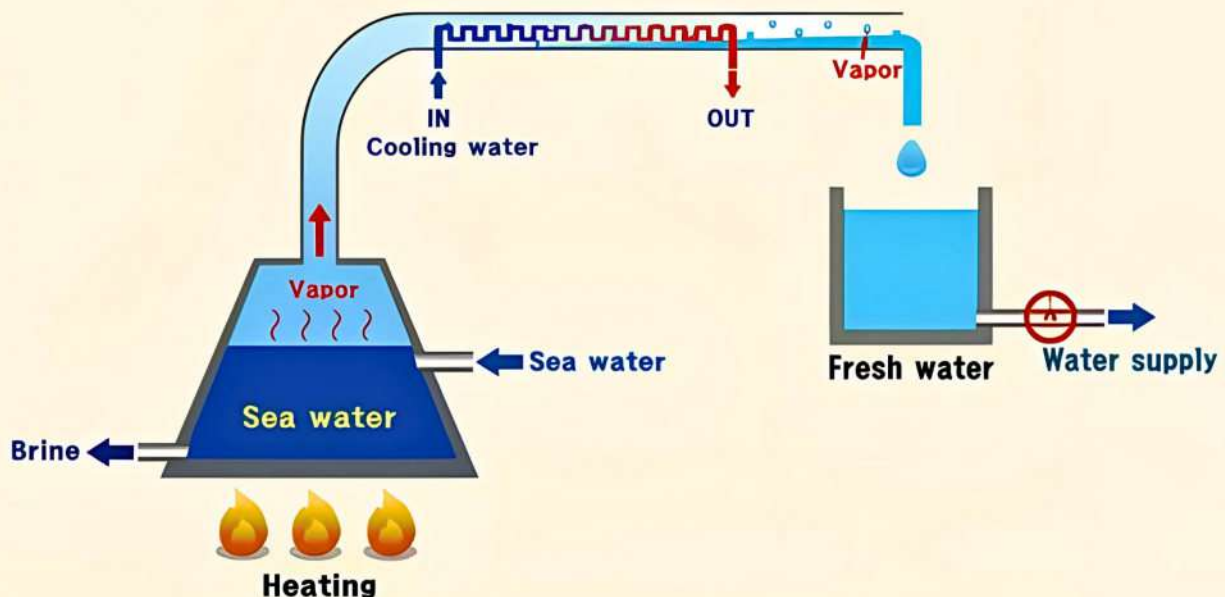
#### ✓ Why is Desalination Important?

- Solves freshwater shortages in dry regions.
- Provides clean drinking water in areas with limited resources.
- Reduces dependence on natural freshwater sources.

✳ Commonly used in dry regions where freshwater is scarce.

✳ Countries with low freshwater sources (e.g., Saudi Arabia, UAE) rely on desalination.

### Thermal Desalination Principle



The most important points of the lesson

Process	Definition	Example
Evaporation	Liquid water gains heat and turns into gas	Water drying in the sun
Condensation	Water vapor loses heat and turns into liquid	Cloud formation
Precipitation	Water falls from clouds due to gravity	Rain, snow, or hail
Surface Runoff	Rainwater flows into rivers, lakes, and oceans	River flow after rainfall

- ✓ The water cycle ensures continuous water renewal.
- ✓ The sun and Earth's gravity maintain the water cycle.
- ✓ Desalination provides freshwater in water-scarce regions.

The Water Cycle & Environmental Balance

- ✓ Why is the Water Cycle Important?
  - Maintains global water balance.
  - Supports plant and animal life.
  - Regulates Earth's climate and temperature.
  - Provides freshwater for drinking and irrigation.

- ✓ Human Impact on the Water Cycle:
  - ✗ Deforestation reduces transpiration
  - ✗ Pollution affects water quality .
  - ✗ Overuse of freshwater leads to water shortages.

How Can We Protect Water Resources?

- 1.Reduce water waste .
- 2.Prevent pollution of rivers and lakes .
- 3.Encourage rainwater harvesting .



## words of the lesson

Water cycle	دورة الماء	Water spot	بقعة مائية
Necessary	ضروري	Thunder storm	عاصفة رعدية
Prudent use	الاستخدام الرشيد		
Conservation	الحفاظ		
Sustainability	الاستدامة		
Water bodies	المسطحات المائية		
Sanitation	الصرف الصحي		
Hygiene	النظافة		
Regulation	تنظيم		
Rubber band	شريط مطاطي		
Evaporation	التبخّر		
Inclined rays	الأشعة المائلة		
Vertical rays	الأشعة العمودية		
Condensation	التكاثف		
The reverse	العكس		
Transpiration	النتح		
Perspiration (sweat)	التعرق (العرق)		
Precipitation	الهطول		
Surface runoff	الجريان السطحي		
Infiltration	التسرب (الترشيح)		
Hail	البرد		
Renewed	متجدد		
Desalination	تحلية المياه		

Questions



EL-MOASSER

1 Choose the correct answer:

1 Clouds and rain are formed through the processes of .....

- ☐ a condensation and precipitation      ☐ B condensation and evaporation.  
☐ C evaporation and surface runoff.      ☐ D precipitation and surface runoff.

2 What are the two processes that occur at any temperature ?

- ☐ a Melting and boiling      ☐ B Evaporation and condensation  
☐ C Melting and evaporation      ☐ D Evaporation and boiling

3 The percentage of water on the Earth's surface is approximately .....

- ☐ a 3%      ☐ B 29%      ☐ C 70%      ☐ D 71%

4 What is the process which leads to the disappearance of a water spot found on the surface of a house?

- ☐ a Condensation      ☐ B Precipitation      ☐ C Evaporation      ☐ D Erosion

5 What is the process that the plants carry out in the water cycle?

- ☐ a Condensation.      ☐ B Evaporation      ☐ C Precipitation      ☐ D Transpiration

6 The process that precedes condensation directly in the natural water cycle is.....

- ☐ a surface runoff      ☐ B evaporation      ☐ C infiltration      ☐ D precipitation

7 Each of the following is a factor that helps in the movement of water during the water cycle, except.....

- ☐ a gravity      ☐ B clouds      ☐ C wind      ☐ D sun

8 In which of the following pathways of the natural water cycle, the water is in the liquid state ?

- ☐ a Precipitation and transpiration.      ☐ B Infiltration and surface runoff.  
☐ C Clouds and hail.      ☐ D Hail and transpiration.

9 Each of the following is a process that occurs during the natural water cycle, except .....

- ☐ a erosion      ☐ B transpiration      ☐ C precipitation      ☐ D infiltration

2 Complete the following statements :

- 1 Water is used for drinking,.....and....., it plays a vital role In regulating..... of Earth planet.
- 2 Water exists in the wind in the ..... state and exists in the clouds In the.....and .....states..
- 3 Water vapour condenses and turns into droplets of water upon.....thermal energy, while ice melts turning into liquid water upon..... thermal energy.
- 4 In the conversion processes of the matter.....and.....processes occur at any temperature, while the.....process occurs at a certain temperature.
- 5 Sources of water vapour in nature include.....and .....
- 6 When small..... accumulate during thunderstorms.....precipitation.
- 7 A portion of rainwater Infiltrates into the cracks of the Earth's surface due to....., and is stored as.....
- 8 The two main factors that maintain the continuity of the water cycle in nature are..... and .....
- 9 The process of ..... is carried out to face the shortage of freshwater resources in remote areas .

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 Water represents about 71% of the human body. ☐
- 2 Liquid water converts into ice through condensation process. ☐
- 3 The rate of evaporation In tropical regions Is faster than that in polar regions. ☐
- 4 Ice in polar regions melts when It loses thermal energy and converts into water. ☐
- 5 Water evaporates from water bodies due to energy derived from the effect of the sun's heat. ☐
- 6 water transfers from the oceans to tho air through surface runoff procoss. ☐
- 7 When the temperature of the clouds is higher than tho freezing point, snow precipitates instead of rain. ☐

5 Correct the underlined words:

- (1) The land covers about 3% of the composition of Earth's surface.
- (2) Water vapour convorts into liquid water through the melting procoss,
- (3) Melting process Is the reverse of condensation procoss.
- (4) Clouds are formed through the freezing of water vapour found in the air.
- (5) Gravity acts to move water from the ground to tho air.
- (6) The concept of water desalination depends on the processes of bolling and condensation.

5 Mention the importance (or use) of one for each of the following:

- (1) Water.
- (2) The sun's heat in the water cycle.
- (3) Wind in the water cycle.
- (4) The gravitational force of Earth in the water cycle.
- (5) Seawater desalination.

5 What is meant by each of the following:

- (1) Evaporation.
- (2) Condensation.
- (3) The water cycle.
- (4) Transpiration.
- (5) Precipitation.
- (6) Surface runoff.
- (7) Seawater desalination.

5 Write what the following percentages :

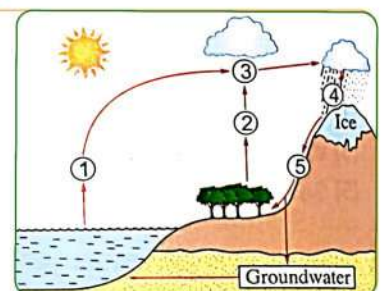
- (1) 70%
- (2) 71%
- (3) 3%
- (4) 29%

5 What are the difference and the similarity

( the evaporation - the boiling processes ) of water

5 From the opposite figure :

- (1) What does this diagram express ?
- (2) Replace the numbers from (1) to (5) with the suitable processes.



The Rock Cycle

Rocks

are solid materials composed of one or more minerals.

They are found on :

- ✓ On Earth's surface
- ✓ Beneath Earth's crust
- ✓ At the bottom of oceans and seas
- ✓ Example: Granite Rock Composition



Granite is made up of three main minerals:

Quartz



Feldspar



Hornblende



NOTES

- Rocks are constantly changing over time due to natural processes.

Classification of Rocks

Rocks are classified based on *how they form* into three main types:

Type	Formation Process	Examples
Sedimentary Rocks	Formed from compressed sediments over time.	Limestone, Sandstone, Claystone
Metamorphic Rocks	Formed when existing rocks undergo heat & pressure without melting.	Marble, Quartzite
Igneous Rocks	Formed from cooled magma or lava.	Granite, Basalt, Pumice

The rock cycle

describes how one rock type transforms into another through geological processes.

Geological Processes Affecting Rock Formation

Process	Definition	Effect on Rocks
Weathering	The process of <b>breaking down</b> and fragmenting the rocks, which may take millions Of years.	<b>Forms sediments.</b>
Erosion	<b>Transporting</b> rock fragments away from their original location.	<b>Moves sediments.</b>
Melting & Crystallization	Rocks <b>melt</b> into magma and later <b>cool</b> to form new rocks.	<b>Forms igneous rocks.</b>

Weathering (Breakdown of Rocks)

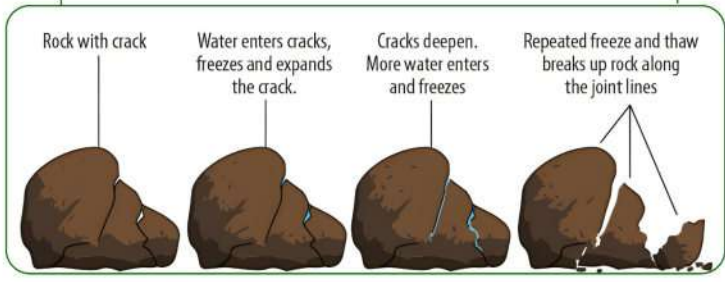
A. Mechanical Weathering

Definition:

- The physical breakdown of rocks **without changing** their chemical composition.

✓ Causes of Mechanical Weathering:

1. **Freezing and thawing of water** in rock cracks
2. **Flowing water** that wears down rocks
3. **Strong winds** carrying sand particles
4. **Plant roots growing inside rock cracks**
5. **Expansion & contraction** of minerals due to temperature changes



B. Chemical Weathering

Definition:

- The breakdown of rocks **due to chemical reactions**, **changing** their chemical structure.

✓ Causes of Chemical Weathering:

1. **Acid rain** reacting with limestone
2. **Mineral-rich hot springs** dissolving rocks
3. **Groundwater containing acids** corroding rocks
4. **Oxygen reacting with minerals** to form rust

Example: Spherical Weathering

- Corners of rocks erode faster, turning them into rounded shapes over time.



NOTES

- **Yellowstone hot springs** show chemical weathering as mineral-rich hot water breaks down rocks and alters their composition.

## NOTES

Why is melting ice NOT chemical weathering?

- Because there is **no chemical change** — only a change in state.



## Life Application :

- Calcium carbonate from crushed limestone is used to make casts for broken bones.

## Erosion (Transportation of Rock Fragments)

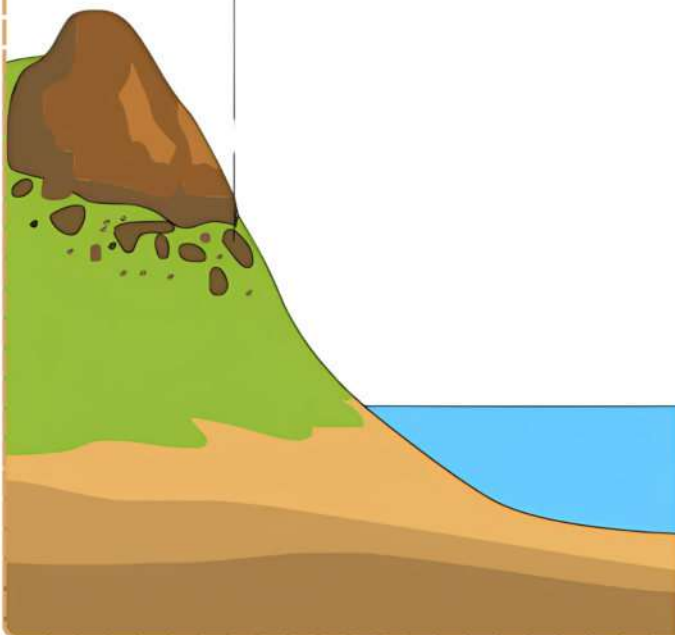
### Erosion

- moves rock fragments (sediments) from their original location to new areas.

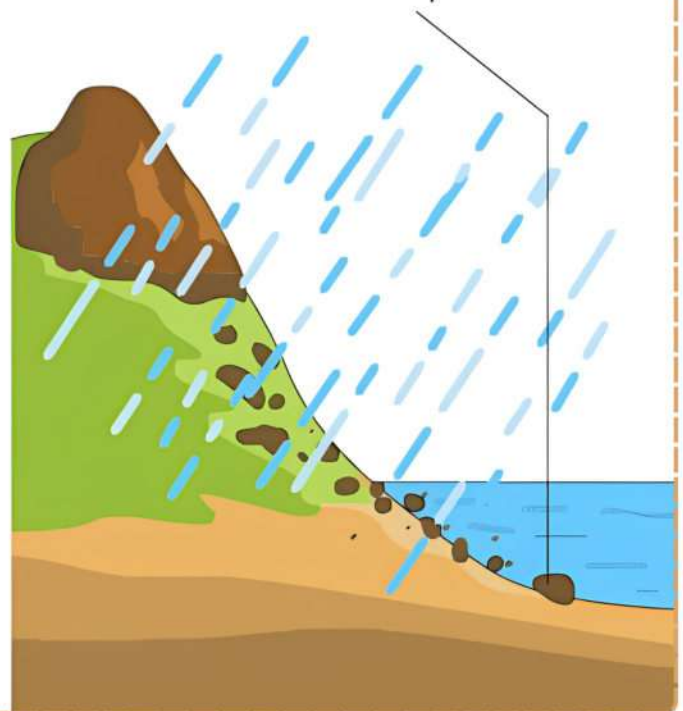
## Process of Erosion:

1. Weathering breaks down rocks into small pieces.
2. Water, wind, or ice transport these sediments.
3. Sediments settle in new locations (sedimentation).

Weathering causes the rock to break down



Erosion and transport moves the sediments downhill to another place





## Factors Affecting Erosion:

1. Fast-moving water transports larger sediments.
2. Slower water carries only small sediments.

## NOTES

### Erosion: Helpful or Harmful?

- **Positive effect:** Forms fertile soil & river deltas
- **Negative effect:** Causes coastal erosion & landslides

### 1 Formation of Sedimentary Rock



### 2 Formation of Metamorphic Rocks



### 3 Formation of Igneous Rocks

## 1 Formation of Sedimentary Rock

1. Over time, sediments accumulate in layers.
2. Pressure compresses them into solid rocks (lithification).

## Examples of Sedimentary Rocks:

Limestone



Sandstone



Claystone



## Characteristics of Sedimentary Rocks:

1. Porous (contain air spaces).
2. Contain fossils of ancient organisms.

## 2 Formation of Metamorphic Rocks

- Formed when existing rocks are exposed to heat & pressure without melting

### Process:

- Heat & pressure push rock particles closer together.
- Minerals rearrange, making the rock denser & harder.

### Examples of Metamorphic Rocks:

Marble (from limestone)



Quartzite (from sandstone)



### NOTES

\* Metamorphic rocks are stronger than sedimentary rocks

- because of high pressure & heat.

## 3 Formation of Igneous Rocks

- Formed when magma or lava cools & solidifies.

### Process:

- Deep inside the Earth, rocks melt into magma due to extreme heat.
- Magma rises & escapes through volcanoes as lava.
- Lava cools & hardens into solid igneous rock.

### Types of Igneous Rocks:

Type	Formation	Example
Plutonic Igneous Rocks	Magma cools slowly inside Earth	Granite, Gabbro
Surface Igneous Rocks	Lava cools quickly on the surface	Basalt, Pumice

### NOTES

\* Why can we see granite crystals but not basalt crystals?

- Granite cools slowly, forming large visible crystals.
- Basalt cools quickly, forming small invisible crystals.

### Magma

- Hot molten material formed by melting minerals inside the Earth's interior.

### Lava

- Magma when it reaches the Earth's surface,

Life Application

- ✓ Limestone was used to build the Pyramids of Giza. 🏛️
- ✓ Marble was used to construct the Taj Mahal. 🕌



The Rock Cycle

The Rock Cycle

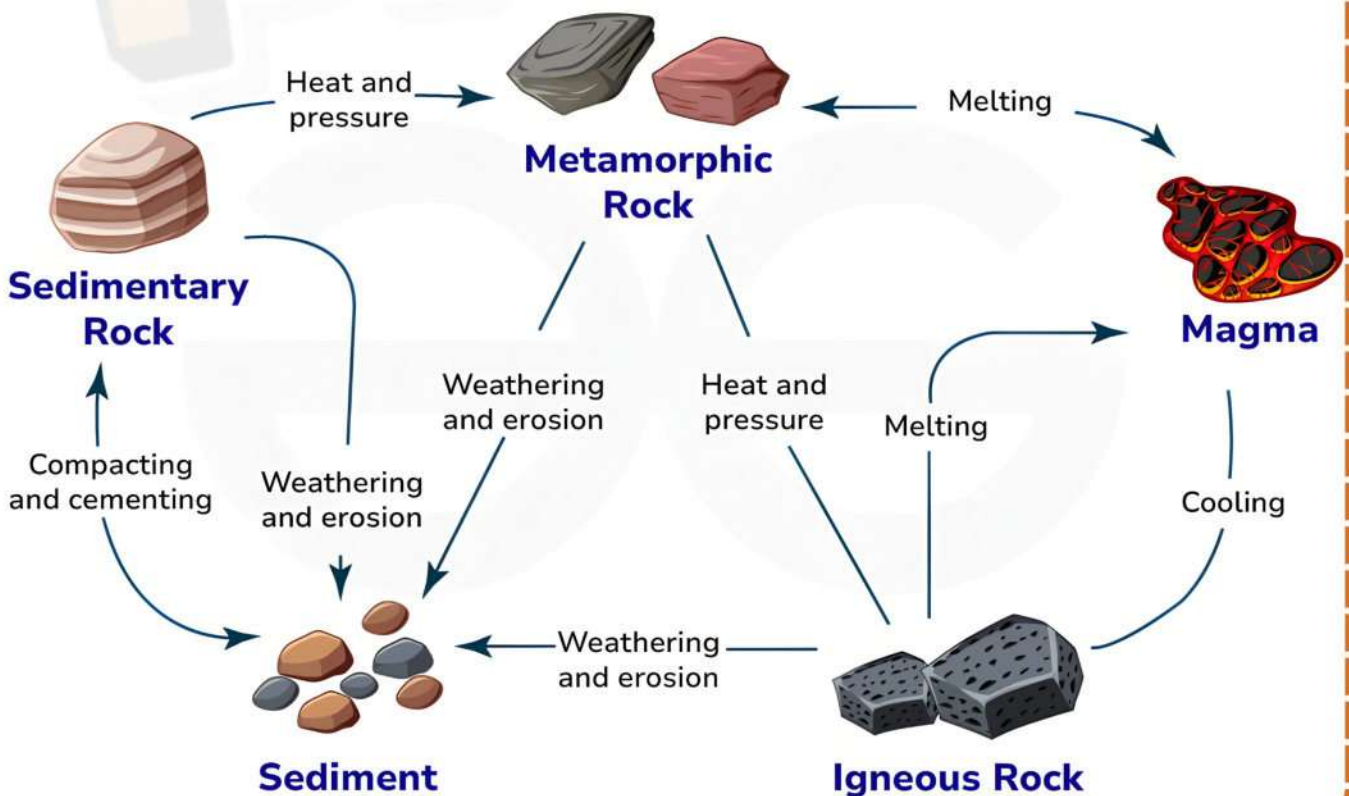
- A continuous process where rocks transform into different types over time.

Processes in the Rock Cycle:

1. **Weathering & Erosion** → Break down rocks into sediments.
2. **Sedimentation & Lithification** → Form sedimentary rocks.
3. **Heat & Pressure** → Form metamorphic rocks.
4. **Melting & Crystallization** → Form igneous rocks.

( The Rock Cycle Never Stops )

Diagram of rock cycle



## Fossil Fuel Formation

### Fossil fuels الوقود الأحفوري:

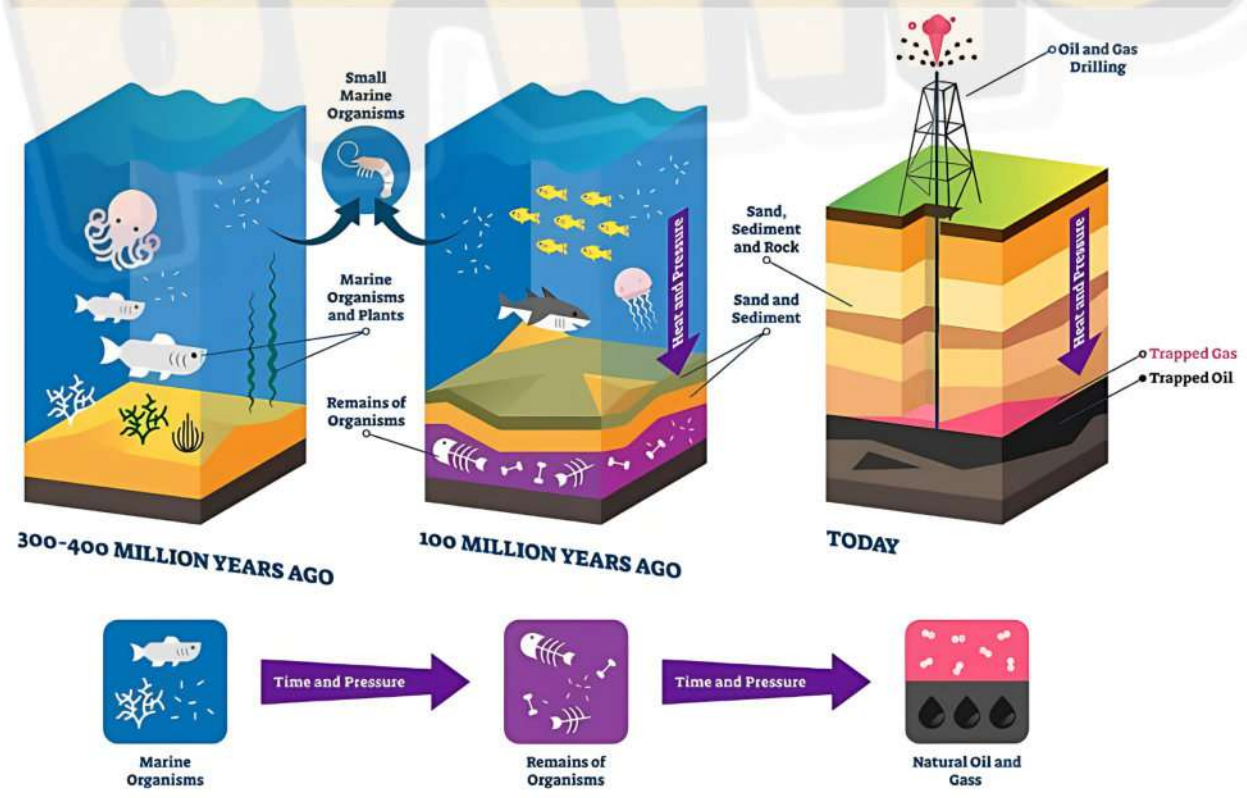
- Natural fuels formed from the remains of ancient plants and animals buried under layers of earth for millions of years.

### Process of Fossil Fuel Formation:

- Sunlight is stored in plants through photosynthesis.
- Plants & animals die and get buried underground.
- Over millions of years, heat & pressure turn them into fossil fuels.

### Types of Fossil Fuels & Origins:

Type	Source
Coal 🪨	Dead trees & plants
Petroleum (Oil) 🛢️	Marine microorganisms
Natural Gas 🔥	Marine microorganisms (mainly Methane CH <sub>4</sub> )



### NOTES

- Methane gas is the main component of natural gas, making up over 90% of it.
- Coal & oil are used for electricity & fuel.
- Natural gas is used for cooking & heating.

## words of the lesson

Granite rock	صخر الجرانيت	Limestone	الحجر الجيري
Beneath	تحت	Lit matchstick	عود ثقاب مشتعل
Sedimentary rocks	الصخور الرسوبية	Corroded	متآكل
Metamorphic rocks	الصخور المتحولة	Hot springs	الينابيع الساخنة
Igneous rocks	الصخور النارية	Spherical weathering	التجوية الكروية
Geological processes	العمليات الجيولوجية	Crushing	السحق
Weathering	التجوية	Casts	القوالب
Erosion	التعرية	Bone fractures	كسور العظام
Melting	الانصهار	Ethiopian Plateau	هضبة إثيوبيا
Crystallization	التبلور	Sediments	الرواسب
Mechanical weathering	التجوية الميكانيكية	Transportation	النقل
Chemical weathering	التجوية الكيميائية	Deposition	الترسيب
Securely closed	مغلق بإحكام	Gravel	الحصى
Cracks	شقوق	Silt	الطمي
Seeps	يتسرب	Clay	الطين
Expands	يتمدد	Double-edged sword	سيف ذو حدين
Widen	يوسّع	Coastlines (coastal) erosion	تآكل السواحل
Water flow	تدفق الماء	Lithification	التصخر
Wind blowing	هبوب الرياح	Compacted	مضغوط
Thermal expansion	التمدد الحراري	Cemented (cohesive)	متماسك (متصلب بالأسمنت)
Thermal contraction	الانكماش الحراري	Porous	مسامي
Solidification	التصلب	Exposure	تعرض
Plutonic igneous rocks	الصخور النارية الجوفية	Molten	منصهر
Surface igneous rocks	الصخور النارية السطحية	The Earth's interior	داخل باطن الأرض

Questions



EL-MOASSER

1 Choose the correct answer:

1 All the following factors lead to weathering, except .....

- ☐ a wind blowing
- ☐ B growth of plant roots within rock Cracks
- ☐ C melting and crystallization
- ☐ D acids present in groundwater.

2 Which of the following is a correct classification of certain rocks ?

- ☐ a Gabbro is a surface igneous rock.
- ☐ B Granite is a plutonic igneous rock.
- ☐ C Marble is a sedimentary rock.
- ☐ D Claystone is a metamorphic rock.

3 The occurrence of physical and chemical changes to the marine microorganism that have been buried for millions of years results in the formation of.....

- ☐ a coal and petroleum oil.
- ☐ B coal and natural gas.
- ☐ C natural gas and petroleum oil.
- ☐ D all types of fossil fuels.

4 The three types of rocks are classified according to .....

- ☐ a the way they are formed.
- ☐ B the depth at which they are found.
- ☐ C their chemical properties.
- ☐ D their relative age.

5 Metamorphic rocks are formed through the processes of.....

- ☐ a melting and crystallization.
- ☐ B transportation and sedimentation.
- ☐ C heat and pressure.
- ☐ D erosion and weathering.

6 The rock cycle is a model that illustrates.....

- ☐ a the unchanging of rocks.
- ☐ B how magma is formed.
- ☐ C how sediments are formed.
- ☐ D transformations of rocks.

7 Which of the following illustrates the correct sequence for the formation of sandstone rocks ?

- a** Weathering → Transportation → Sedimentation.
- B** Erosion → Weathering → Sedimentation.
- C** Melting → Cooling → Crystallization.
- D** Pressure → Heat → Crystallization.

8 River deltas are formed as a result of a process called .....

- a** crystallization
- B** chemical weathering.
- C** melting
- D** erosion

9 Limestone is composed of.....

- a** sodium carbonate
- B** calcium carbonate.
- C** ammonium sulphate
- D** calcium sulphate

10 Among the forms of the chemical weathering is .....

- a** the weathering by water flow
- B** the weathering by plant roots.
- C** the spherical weathering
- D** the weathering by wind blowing.

11 Which of the following rocks is used after being crushed to make casts ?

- a** Gabbro.
- B** Limestone
- C** Sandstone
- D** Pumice

12 Which of the following illustrates a sedimentary rock and the metamorphic rock resulting from it?

- a** Sandstone → Limestone.
- B** Limestone → Marble.
- C** Quartzite → Sandstone
- D** Marble → Quartzite.

13 From the rocks that is formed due to the exposure to extreme pressure and heat is.....

- a** quartzite.
- B** gabbro
- C** pumice
- D** claystone

14 When lava cools, it forms a rock called .....

- a** gabbro.
- B** pumice
- C** granite
- D** sandstone

15 From the plutonic igneous rocks is .....

- a** granite
- B** marble
- C** basalt
- D** quartzite

16 The rock used in the construction of Taj Mahal in India is.....

- a** limestone      **B** pumice      **C** marble      **D** granite

17 The remains of marine microorganism transform after millions of years in the Earth's interior into .....

- a** granite      **B** limestone      **C** petroleum oil      **D** coal

18 What is the gas which comprises more than 90% of natural gas?

- a** Carbon dioxide      **B** Chlorine      **C** Nitrogen      **D** Methane

2 Complete the following statements :

1 .....is the process of breaking down and fragmenting rocks, while..... is the transport of sediments from one location and their sedimentation in another.

2 Basalt is an ..... igneous rock, while granite is an ..... igneous rock.

3 Large plants represent the organic origin of..... fuel, while marine microorganisms represent the organic origin of..... fuel.

4 .....is the rock used after being crushed in making casts for bone fractures.

5 .....gas forms more than 90% of the natural gas.

6 Hot springs of ..... of National Park in USA represent an example of..... weathering.

7 The organic origin of coal is....., while the organic origin of natural gas is.....

8 The rock of ..... was used in building the Pyramids of Giza which it belongs to..... rocks

9 .....powder resulting from crushing.....rock is use In making casts.

3 put ( ✓ ) or ( x ) for each statement , with correction:

- 1 The volume of water increases when it freezes in the cracks of rocks, causing chemical weathering. ☐
- 2 The minerals in rocks expand at night due to the drop in temperature. ☐
- 3 Limestone is a sedimentary rock that is corroded by acidic rains. ☐
- 4 Quartzite is harder than sandstone. ☐
- 5 Plutonic igneous rocks are formed by the effect of exposure to extreme pressure and heat. ☐
- 6 Magma takes a long time to crystallize, hence forming rocks with large crystals. ☐
- 7 Pumice is considered as a plutonic igneous rock with small crystals. ☐
- 8 Plants store light energy in the form of chemical energy through the photosynthesis process. ☐
- 9 Plants represent the organic origin of natural gas. ☐

5 Write the scientific term of each of the following statements.

1. Solid materials composed of one or several minerals.
2. The process of breaking down and fragmenting rocks, that may take millions of years.
3. The process of breaking down and fragmenting rocks without any change in their chemical structure.
4. The process of breaking down and fragmenting rocks with a change in their chemical structure.
5. Chemical weathering that leads to the formation of spheres of rocks.
6. The processes of transportation and sedimentation rock fragments which resulting from weathering away from the areas where they were originally found.
7. Rock fragments transported away from the area in which weathering occurred.
8. Cohesive rocks formed from the lithification of sediments.
9. The compaction of sediments over the years into layers forming sedimentary rocks.
10. The rocks formed through the exposure of rocks located beneath the Earth's surface to extreme pressure and heat without reaching their melting point.
11. Molten rocks in the Earth's interior.
12. Magma when it reaches the Earth's surface.
13. Rocks formed from the solidification of lava or magma.
14. Rocks formed from the slow cooling of magma in the cracks of the Earth's crust.
15. Rocks formed from the rapid cooling of lava on the surface of the Earth's crust.
16. The transformation of rocks from one type to another.
17. The fuel formed in the Earth's interior.

**5 Give one example for each of the following:**

1. National park represents an example of chemical weathering.
2. A sedimentary rock.
3. A metamorphic rock.
4. A plutonic igneous rock.
5. A surface igneous rock.
6. A sedimentary rock used anciently in the construction.
7. A metamorphic rock used in the construction.
8. A fossil fuel of organic origin from marine microorganisms.
9. A fossil fuel of plant organic origin.

**5 Mention one difference between each of the following :**

- |                             |                              |
|-----------------------------|------------------------------|
| (1) Weathering and erosion. | (2) Sandstone and quartzite. |
| (3) Gabbro and pumice.      | (4) Coal and petroleum oil.  |

**5 compare between each of the following :**

1. Mechanical weathering and chemical weathering "In terms of: Definition - Causes".
2. Magma and lava "In terms of: Definition - The rocks formed by their cooling".
3. Plutonic igneous rocks and surface igneous rocks "In terms of: Way of formation - Size of crystals - One example for each of them".
4. Granite and basalt "In terms of: Type of rock - Size of crystals - way of formation".
5. Igneous rocks and sedimentary rocks "In terms of: Way of formation - Example".
6. Marble and limestone "In terms of: Type of rock - Way of formation - Usage".

**5 Choose the odd word (or phrase) out, then write the relation between the rest:**

1. Weathering / Climate / Erosion / Melting and crystallization.
2. Water freezing in cracks of rocks / Acid rains / Expansion of rock minerals during the day / Wind blowing.
3. Lithification / Fragmentation / Sedimentation / Crystallization.
4. Limestone / Marble / Sandstone / Claystone.
5. Used in the construction of the Pyramids of Giza / Sedimentary rock / Metamorphic rock / Its powder is used in making casts.
6. Gabbro / Pumice / Granite / Quartzite.
7. Natural gas / Coal / Petroleum oil / Basalt.



# **A BRIGHT BATH TO EXCELLENCE**